Vol. 9, No. 1
January 15, 1984

Energy Research Abstracts

Abstracts 1-1756

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1303; FTS 626-1303.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $6.00, foreign $7.50 per copy; annual cumulative index, domestic $10.00, foreign $12.50 per copy. The annual subscription price is $70.00 for domestic subscribers and $87.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign).

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription as PB84-946800 from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic subscribers and $28.00 for subscribers outside the North American continent; prices for single issues are $7.00 and $14.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers. A single issue is $7.00 (domestic) and $14.00 (foreign).

***Current Energy Patents (CEP)*–PB84-902800**

Provides coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB84-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB84-914600**

Devoted to information on the exploration, development, processing and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB84-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB84-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

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Covers all aspects of acid precipitation, including effects and possible control measures.

***Coal-Based Synfuels (CBS)*–PB84-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB84-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB84-946600**

Covers the following areas: photovoltaics; magnetohydrodynamics; electrohydrodynamics; thermoelectrics; thermionics; and fuel cells.

***Geothermal Energy Technology (GET)*–PB84-914700**

Devoted to information on the exploration, development, and utilization of geothermal resources.

***Laser Research (LAR)*–PB84-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB84-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB84-913500**

Covers the following safety aspects: accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB84-902900**

Covers the following management aspects: transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB84-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB84-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Technical Information Center cooperates with the following organizations in the publication of international abstract journals: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts;* and (3) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts.* In each case, the cognizant foreign agency provides the non-U.S. information to TIC for inclusion in the Energy Data Base; in turn, TIC provides the U.S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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Vol. 9, No. 1
ISSN: 0160-3604
CODEN: ERABD
January 15, 1984

ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, Tennessee 37831.

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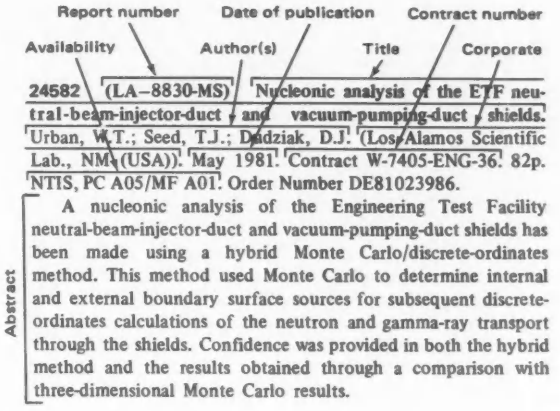
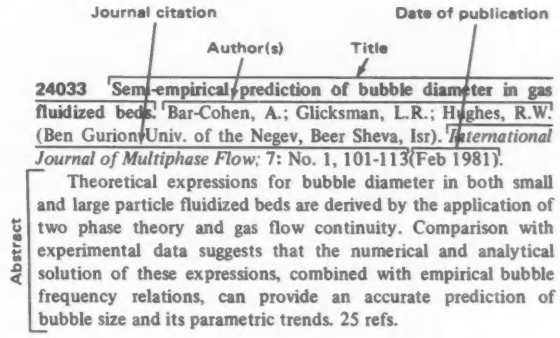
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Contract number
Availability
Author(s)
Title
Corporate
24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.
Abstract
A nucleonic analysis of the Engineering Test Facility neutral-beam-injector-duct and vacuum-pumping-duct shields has been made using a hybrid Monte Carlo/discrete-ordinates method. This method used Monte Carlo to determine internal and external boundary surface sources for subsequent discrete-ordinates calculations of the neutron and gamma-ray transport through the shields. Confidence was provided in both the hybrid method and the results obtained through a comparison with three-dimensional Monte Carlo results.


Journal citation
Date of publication
Author(s)
Title
24033 Semi-empirical prediction of bubble diameter in gas fluidized beds. Bar-Cohen, A.; Glicksman, L.R.; Hughes, R.W. (Ben Gurion Univ. of the Negev, Beer Sheva, Isr.). International Journal of Multiphase Flow; 7: No. 1, 101-113 (Feb 1981).
Abstract
Theoretical expressions for bubble diameter in both small and large particle fluidized beds are derived by the application of two phase theory and gas flow continuity. Comparison with experimental data suggests that the numerical and analytical solution of these expressions, combined with empirical bubble frequency relations, can provide an accurate prediction of bubble size and its parametric trends. 25 refs.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. **(Los Alamos Scientific Lab., NM (USA)).** May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Bar-Cohen, A., Semi-empirical prediction of bubble diameter in gas fluidized beds, 7:24033 (J:US)
Dudziak, D.J., *See* Urban, W.T., 6:24582
Glicksman, L.R., *See* Bar-Cohen, A., 7:24033
Hughes, R.W., *See* Bar-Cohen, A., 7:24033
Seed, T.J., *See* Urban, W.T., 6:24582
Urban, W.T., Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

TOKAMAK ETF
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Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)
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• Contract Number Index

DOE technical literature is indexed using contract numbers under which the literature was produced. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos National Lab., NM (USA)	
	6:24582	LA–8830-MS

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order Number–Report Number Correlation is included for convenience.

LA–		
8830-MS	6:24582	NTIS, PC A05/MF A01. Order Number DE81023986, Distribution Category STD-20d

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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1 **(CONF-8310179—3) New approaches for monitoring PAH exposures at the H-Coal demonstration plant.** Vo-Dinh, T.; Hawthorne, A.R.; Gammage, R.B.; Abbott, D.W. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE84002060.

From 8. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1983).

This paper describes a number of recently developed techniques that were used to characterize fugitive emissions of airborne polynuclear aromatic hydrocarbons (PAH) at the H-Coal Pilot Plant in Catlettsburg, Kentucky. Both area and personnel samples were collected and analyzed. A portable derivative uv absorption spectrometer was used to monitor volatile PAH species such as naphthalene, methylnaphthalene, and indan. Vapors of higher molecular weight PAH such as phenanthrene, pyrene, and fluoranthene were monitored using a new passive personnel monitor recently developed for PAH vapors. Air particulate samples were solvent extracted and ranked according to their PAH content using a cost-effective screening procedure based on synchronous luminescence (SL) and room temperature phosphorescence (RTP). The results of SL/RTP ranking were compared with data obtained by traditional methods such as gas chromatography/mass spectrometry (GC/MS). The results of this study demonstrate that the SL and RTP techniques provide a rapid, efficient, and cost-effective screening procedure to monitor PAHs in workplace environments. The correlations between the SL/RTP and GC/MS data indicate that the screening procedure has a ranking capability appropriate even for samples whose differences in PAH content are much less than one order of magnitude. 12 references, 5 figures, 2 tables.

2 **(DOE/ET/10324—36) Engineering-support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, October-December 1980.** Bostwick, L.E.; Brancheau, R.J.; Chen, R.G. (Kellogg (M.W.) Co., Houston, TX (USA)). 1980. Contract AC01-78ET10324. 37p. (FE—2778-36). NTIS, PC A03/MF A01. Order Number DE83010948.

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Kellogg activities included continued monitoring of test operations at BI-GAS, Westinghouse, Exxon and IGT (for peak gasification). Pilot plant/PDU test runs which were monitored and reported included: BI-GAS tests G-14, G-14A, G-15 and G-15A; Westinghouse PDU tests TP-027-5 and TP-031-1 and CFSF tests TP-M001-1, 2, 3 and 4; Exxon run periods No. 23 and No. 24; and IGT single-stage peat gasification tests BF-1 through BF-6. Draft reports were submitted regarding Hygas data base evaluation, gasifier vessel design and scaleup risks of the Westinghouse oxygen-blown gasifier. Evaluation of the Hygas data base continued, and a similar study of the Peatgas PDU data base was initiated. Work was begun on preparation of a descriptive brochure for the DOE/GRI joint program. Kellogg personnel participated in investigations of welding materials with the MPC. Significant progress was made in the technical/economic assessments of Westinghouse, Exxon and Peatgas and in the technical/economic comparison of Westinghouse and U-gas, with technical definitions being essentially finished and cost estimation begun. Technical definition and preliminary capital cost estimates were completed for the peat harvesting/dewatering study. Work continued in the study of carbonyl formation. Following reviews by the developers, Kellogg began finalization of the report on screening evaluations of Westinghouse, Exxon and Rockwell. Work on the safety assurance study continued, with the commencement of safety audit visits.

3 **(DOE/ET/10324—61) Engineering support services for the DOE/GRI coal-gasification research program. Evaluation of the IGT Peatgas PDU data base.** Bostwick, L.E.; Chen, R.G.; Hubbard, D.A. (Kellogg (M.W.) Co., Houston, TX (USA)). Mar 1982. Contract AC01-78ET10324. 82p. (FE—2778-61). NTIS, PC A05/MF A01. Order Number DE83010943.

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As requested by DOE, Kellogg has reviewed the data base generated by IGT for the Peatgas process during laboratory and PDU testing. Kellogg's central finding, from the review reported here, is that the existing data base contains sufficient evidence to warrant further evaluation of the Peatgas process at pilot plant scale. The existing data base relates to testing with peats from (primarily) Minnesota, North Carolina and Maine. Thermobalance studies were employed to define a few kinetic parameters, i.e., the rate of base carbon conversion. Numerous tests using a small coiled-tube reactor and the lift-line PDU were conducted to investigate hydrogasification, where hydrogen or a steam/hydrogen mixture was the reactive gas. A fluidized bed PDU was employed to investigate steam-oxygen gasification and fluidization relationships were studied. The primary advantages to be gained by Peatgas pilot plant testing are, in Kellogg's opinion, the demonstration and evaluation of the three process stages (drying, hydrogasification and steam-oxygen gasification) in an integrated mode. The lack of integrated operation is a significant shortcoming of the existing data base and as such Kellogg would not recommend use of the data base for purposes other than pilot plant design and preliminary engineering studies. Other more specific comments regarding the data base are given.

4 **(DOE/ET/10324—69) Engineering support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, October-December 1981.** Bostwick, L.E.; Ethridge, T.R.; Starr, D.W.; Shah, K.V.; Hubbard, D.A.; Koneru, P.B.; Smith, M.R.; Ward, W.E.; Wong, E.W.; Zeis, L.A. (Kellogg (M.W.) Co., Houston, TX (USA)). Feb 1982. Contract AC01-78ET10324. 29p. (FE—2778-69). NTIS, PC A03/MF A01. Order Number DE83010951.

Kellogg continued to actively monitor operations at BI-GAS Westinghouse and IGT (for peat gasification). Pilot plant/PDU testing which was monitored and reported includes Westinghouse PDU tests TP-030-3 and TP-031-3 and CFSF test TP-M003-1; Peatgas Pilot Plant test No. 4; and single-stage peat gasification PDU tests BF-22 and BF-23. Kellogg personnel briefed the GRI Project Advisors on current tasks and a DOE representative on peat-related work. The report on the Hygas Data Base Evaluation was approved for issue. Progress was made toward finalizing the report on the Peatgas Data Base Evaluation and the Descriptive Brochure for the DOE/GRI Joint Program. Work on the evaluation of the data base for single-stage peat gasification continued. Review of the Hygas final report was completed.

5 **(DOE/ET/10324—73) Engineering support services for the DOE/GRI coal gasification research program. Quarterly technical progress report, January-March 1982.** Bostwick, L.E.; Ethridge, T.R.; Starr, D.W.; Koneru, P.B.; Hubbard, D.A.; Shah, K.V.; Smith, M.R.; Ward, W.E.; Wong, E.W. (Kellogg (M.W.) Co., Houston, TX (USA)). May 1982. Contract AC01-78ET10324. 34p. (FE—2778-73). NTIS, PC A03/MF A01. Order Number DE83010950.

Kellogg continued to actively monitor operations at BI-GAS, Westinghouse and IGT (for peat gasification). Pilot plant/PDU test runs which were monitored and reported included BI-GAS Tests G-18, G-18A and G-18B; Westinghouse PDU Test TP-032-1 and CFSF Test TP-M003; and Peatgas Pilot Plant Test No. 5. Kellogg also monitored winterization/maintenance activities at BI-GAS and Westinghouse and precommissioning of the IGT Wet Carbonization PDU. The final report on the Hygas Data Base Evaluation was issued, while final revisions were completed for the reports concerning PDU data base evaluations of Peatgas and single-stage peat gasification. Efforts toward completion of the brochure describing the DOE/GRI Joint Program proceeded. Normal MPC activities continued. Several technical progress reports were issued during this quarter.

6 **(DOE/ET/10324—T14) Engineering support services for the DOE/GRI coal gasification research program. Safety audits of pilot plants and PDU's.** Bostwick, L.E.; Hubbard, D.A.; Lee, M.D.; Miller, G.R.; Bernard, D.M. (Kellogg (M.W.) Co., Houston, TX (USA)). Apr 1981. Contract AC01-78ET10324. 42p. (FE—2778-46). NTIS, PC A03/MF A01. Order Number DE83010941.

M.W. Kellogg (formerly Pullmann Kellogg) was requested by DOE to investigate and to evaluate normal and emergency operating procedures and the drawing record systems of the coal gasification pilot plants and process development units (PDU). The purpose of this Safety Audit was to identify deficiencies in operating policies or procedures which could lead to potential hazards. The evaluation of safety-related documentation at the pilot plants and PDU's was also included in the audit. The safety audit visits and meetings were conducted at the following research sites: Bell Aerosopace, BCR BI-GAS, Exxon, IGT Hygas/Peatgas, Rockwell International, and Westinghouse. Kellogg conducted the safety audits requested by DOE. These reviews show the developers as possessing very sincere, positive attitudes toward safety and as being committed to ongoing safety programs. Kellogg found that (in general) all of the developers: use written statements of objectives, operating procedures and check lists; have some form of formal safety training for operators; review equipment and procedural revisions with operators; and maintain timely and accurate drawing records.

7 **(DOE/ET/10324—T15) Engineering support services for the DOE/GRI coal gasification research program. Safety assurance study of high-Btu coal-gasification pilot plants and process development units.** Bostwick, L.E.; Chen, R.G.; Coyle, D.A.; Ethridge, T.R.; Hubbard, D.A.; Scales, D.; Senules, E.A.; Shah, K.V.; Singer, D.L.; Smith, M.R. (Kellogg (M.W.) Co., Houston, TX (USA)). Apr 1981. Contract AC01-78ET10324. 159p. (FE—2778-50). NTIS, PC A08/MF A01. Order Number DE83010969.

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The purpose of this study was to identify risks and provide suggestions to improve and assure the safety of the high BTU coal gasification units (pilot plants and process development units) currently in the joint US Department of Energy and The Gas Research Institute (DOE/GRI) program. This was accomplished by performing a systematic detailed investigation of the gasifiers for each of the processes to identify operating conditions or equipment deficiences that could lead to potential hazards. This report documents the potential hazards identified to date. It is expected that the study will contribute to the improved safety aspect of larger scale production units by providing descriptions of the lessons learned. This safety assurance study involved a detailed systematic investigation of the gasifier area and related equipment of six different gasification units: Bell Aerosopace, BI-GAS, Exxon, Hygas, Rockwell and Westinghouse.

8 **(DOE/ET/10324—T17) Engineering support services for the DOE/GRI coal-gasification research program. Technical and economical comparisons of the Westinghouse and I.G.T. U-Gas coal-gasification processes.** Bostwick, L.E.; Hubbard, D.A.; Laramore, R.W.; Koneru, P.B. (Kellogg (M.W.) Co., Houston, TX (USA)). Jul 1981. Contract AC01-78ET10324. 89p. (FE—2778-45). NTIS, PC A05/MF A01. Order Number DE83010962.

Kellogg was requested by DOE/GRI to prepare technical and economic assessments of the Westinghouse and IGT U-Gas processes such that comparison of the two would be on a consistent basis. Kellogg carried out this task in essentially two phases: (a) preparation of consistent designs of coal-to-SNG plants using the two processes, and (b) evaluation of the design bases in light of research data. Comparable designs and economics were prepared for grass-roots facilities to produce SNG equivalent to 250 billion Btu/day from Pittsburgh No. 8 coal, using the Westinghouse and U-Gas gasifiers. The C.F. Braun Guidelines were followed. The capital and operating costs are almost identical for the two processes. In Kellogg's view, the economics as developed during this study do not show cause to favor either process over the other. The small differences in costs are well within the accuracies of the estimates and should be considered insignificant. Nine differences between the Westinghouse and U-Gas processes are listed which could possibly provide an advantage to one or to the other. Opportunities exist for both processes to enhance efficiencies and/or to reduce costs by optimization of the gas treating and byproduct recovery areas. Kellogg observes that both Westinghouse and U-Gas appear to be very competitive (in economics as developed during this study) with other coal gasification processes evaluated under the Joint DOE/GRI Program.

9 **(DOE/ET/10324—T19) Engineering support services for the DOE/GRI coal gasification research program. Technical and economic assessment of the Exxon Catalytic Coal-Gasification Process.** Bostwick, L.E.; Coyle, D.A.; Laramore, R.W. (Pullman Kellogg, Houston, TX (USA)). Apr 1981. Contract AC01-78ET10324. 39p. (FE—2778-44). NTIS, PC A03/MF A01. Order Number DE83010963.

In this assessment Kellogg utilized operating experience and data from the Exxon PDU wherever possible: modifications to the coal drying system, the catalyst recovery system and gasifier sizing criteria resulted from PDU observation since the previous (1979) screening evaluation. No data describing operation of the gasifier or the pretreatment unit in the PDU were available, however. This study must therefore be regarded as highly speculative, since substantial uncertainties still exist regarding these crucial segments of the Exxon Process. The principal results of this study are that the revised values for total plant investment and net operating cost are reduced by 9 and 2%, respectively, such that the average gas cost is reduced 4%, all in comparison to results of the screening evaluation. Development of additional data during future PDU operation could lead to major increases in capital and operating costs: Kellogg suggests that optimization studies relating the cost of pretreatment and gasification should be undertaken as a high priority task. The overall result of this study agrees with the main conclusion from the screening evaluation: the Exxon CCG process appears to be somewhat superior to the Lurgi process in terms of gas cost. Costs for individual plant sections, for this study, were obtained by modification of costs from the earlier screening evaluation. In general these modifications tended toward decreasing the gas cost. Further changes in the design basis appear (to Kellogg) to be inevitable, however, and could lead to major increases or decreases in the gas cost. Effects of possible changes cannot presently be predicted.

10 **(DOE/ET/10324—T20) Engineering support services for the DOE/GRI coal gasification research program. Cost/benefit analysis of extending demonstration run of Westinghouse PDU from 15 days to 30 days.** Bostwick, L.E.; Hubbard, D.A. (Pullman Kellogg, Houston, TX (USA)). Feb 1979. Contract AC01-78ET10324. 36p. (FE—2778-52). NTIS, PC A03/MF A01. Order Number DE83010959.

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At the request of DOE, Pullman Kellogg has investigated the costs and technical advantages of extending a planned 15-day

demonstration run of the Westinghouse process development unit to 30 days. This reactor, in Waltz Mill, Pennsylvania, has been operated during test runs over a two-year period in both air-blown and oxygen-blown modes with a variety of coal feedstocks. Kellogg obtained reactor operating data, descriptions and costs of additional hardware required, and information regarding other costs from Westinghouse. Based on its investigation, Kellogg offers these general conclusions: analysis of operating data and the dynamics of the gasifier indicate that a 15-day length for the demonstration run should be sufficcient to allow any slowly-developing effects to be observed; and the extra cost for extending the run to 30 days is $0.8 to 0.9 million based on Westinghouse information which seems satisfactory. Other factors which might affect the decision are discussed briefly. (LTN)

11 **(DOE/ET/10324—T21) Engineering support services for the DOE/GRI coal-gasification research program. Technical consultation on the Westinghouse process development unit.** Bostwick, L.E.; Gunderson, J.M.; Hubbard, D.A.; Scales, C.D.; Burlingame, R.S.; Snelson, R.K.; Keller, S.E. (Pullman Kellogg, Houston, TX (USA)). Sep 1979. Contract AC01-78ET10324. 60p. (FE—2778-51). NTIS, PC A04/MF A01. Order Number DE83010965.

DOE requested that Pullman Kellogg provide technical consultation on the Westinghouse P.D.U. This task involves three major areas along with several points of consideration within the areas, including: (1) Gasifier Cyclone Modifications and Controls; (2) Estimation of PDU Gasifier Heat Loss; and (3) Pneumatic Transport of Wet Coal. It was concluded: (1) that the cyclone modifications will improve performance (two further modifications are suggested) and that the existing controls are sufficient. (2) Pullman Kellogg estimates a lower PDU heat loss than Westinghouse (by about 25 percent) with some causes of the difference identified. The heat loss is about 13.5% of the heat of reaction on the PDU but is estimated to be only 0.5 percent on a commercial size unit. (3) Empirical data from various vendors suggest the moisture control of the coal be kept below 7.5% to avoid agglomeration.

12 **(DOE/ET/10324—T22) Engineering support services for the DOE/GRI coal-gasification research program. Addendum to C.F. Braun report FE-2240-46, basic requirements for the design and construction of gasifier vessels.** Bostwick, L.E.; Hung, D.T.; Glasgow, P.E. (Kellogg (M.W.) Co., Houston, TX (USA)). Apr 1981. Contract AC01-78ET10324. 26p. (FE—2778-53). NTIS, PC A03/MF A01. Order Number DE83010966.

The C.F. Braun and Co. report FE-2240-46, Basic Requirements for the Design and Construction of Gasifier Vessels, is a well-organized, well-written and comprehensive compendium of information. Kellogg's review of the document disclosed certain areas in which revisions would increase the usefulness of the document to the designer/constructor of gasifier vessels. Rather than rewriting and revising the Braun report, Kellogg proposed, and the DOE/GRI Joint Operating Committee agreed, that an addendum to the report would be of greatest utility. The Kellogg addendum to the C.F. Braun report supplements, amplifies, and updates the Braun information so that the total body of information is compatible with the various codes and practices of vessel design and construction. Paragraph numbers in the Kellogg addendum correspond to the numbers in the Braun report. To avoid confusion, in each of 33 revisions the complete paragraph is included, even though the revision may be the changing of only a few words. Following each such revision is a short comment that outlines the reason for the revision. Kellogg believes that this type of treatment allows side-by-side comparison of the paragraphs and thus results in the greatest utility to the designer/constructor of gasifier vessels.

13 **(DOE/ET/10324—T24) Engineering support services for the DOE/GRI coal-gasification research program. Metal-carbonyl formation in coal-gasification processes.** Montgomery, R.L. (Kellogg (M.W.) Co., Houston, TX (USA)). Apr 1981. Contract AC01-78ET10324. 76p. (FE—2778-54). NTIS, PC A05/MF A01. Order Number DE83010964.

The possibility of carbonyl formation should be taken into account at the design stage. Formation of carbonyls in a coal gasification process is not only a potential problem for the user of the gas but may result in corrosion and/or catalyst damage in the gasification process itself. Designers should make use of the methods for preventing carbonyl formation that are described in the section entitled Methods of Control. Equilibrium and kinetic data are given in this report along with suggestions as to where further data may be found. Carbonyls can be removed from gas streams by the methods described in the section entitled Methods of Control. It may be necessary to remove carbonyls from gas streams if they appear unexpectedly or if it is uneconomic to completely prevent their formation in a particular design. The formation of solid deposits on and around gas burners has been reported at lower concentrations of carbonyl than any other problem caused by the presence of carbonyls. The maximum permissible concentration of carbonyls in SNG is therefore set by the need to avoid such deposits. A tentative limit of 0.01 ppMV was obtained by a reasonable extrapolation of European data. Since the exact mechanism of formation of the solid deposits is unknown, this extrapolation from one gas composition to another is suspect. New experiments should be performed to determine the effects of carbonyls in forming solid deposits on and around gas burners using SNG. Recommendations for specific further studies are given.

14 **(DOE/ET/10324—T25) Engineering support services for the DOE/GRI coal-gasification research program. Technical and economic assessment of the Westinghouse fluidized-bed coal gasification process.** Bostwick, L.E.; Hubbard, D.A.; Laramore, R.W.; Ethridge, T.R. (Kellogg (M.W.) Co., Houston, TX (USA)). Apr 1981. Contract AC01-78ET10324. 63p. (FE—2778-43). NTIS, PC A04/MF A01. Order Number DE83010967.

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Kellogg was requested by DOE/GRI to perform a technical and economic assessment of the Westinghouse fluidized bed coal gasification process as applied to production of SNG equivalent to 250 billion BTU/day from Pittsburgh No. 8 coal. Based on operating experiences in the PDU, where most of the key variables have been demonstrated during 5+ years of testing, Westinghouse provided process data for the gasifier area. Kellogg selected the overall processing sequence and established design bases for the balance of the plant. This work was subsequent to a previous (1979) screening evaluation of Westinghouse by Kellogg: comparison of the two designs reveals the following: The 1980 gasifier design basis, while more detailed, is almost identical to that of 1979. The gas treatment and sulfur recovery schemes were significantly changed: Combined shift/methanation was substituted for stand-alone reaction units; independent Selexol units for removal of H_2S and CO_2 replaced a non-selective Benfield unit; and a Claus-SCOT combination replaced Stretford units and significantly improved the flue gas desulfurization. Key results of the current efforts are compared with those of the screening evaluation. The reductions in efficiencies in the new calculations are attributed to a more realistic evaluation of plant energy requirements and to lack of optimization of individual plant section designs. The economic data indicate that a noteworthy reduction in gas cost was accomplished by a reduction in the capital cost of the plant, such that Kellogg concludes, as previously for the screening evaluation, that the Westinghouse process appears to be superior to existing processes (i.e., Lurgi) and at least competitive with other processes evaluated under the DOE/GRI joint program.

15 **(DOE/ET/10324—T39) Engineering support services for the DOE/GRI coal-gasification. Evaluation of Hygas pilot-plant data base.** Bostwick, L.E.; Hubbard, D.A.; Smith, M.R.; Chen, R.G. (Kellogg (M.W.) Co., Houston, TX (USA)). Nov 1981. Contract AC01-78ET10324. 79p. (FE—2778-47). NTIS, PC A05/MF A01. Order Number DE83010945.

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The overall impression is that the information is adequate for demonstration plant design. The conditions of the steam-oxygen gasifier in the Procon design, however, are not supported by pilot plant data, so less severe conditions should be chosen. The data is, in Kellogg's opinion, adequate but not overly convincing for use as a basis for demonstration plant design. IGT used their kinetic (computer) model to correlate pilot plant data and to forecast perform-

ance at e.g. demonstration plant design. While Kellogg accepts mathematical modeling as a viable means of data extrapolation, a moderate degree of risk is perceived in this particular case. The IGT model was developed from the nonintegrated PDU results and updated using pilot plant data. However, comparisons of actual pilot plant data with calculated values indicate fairly good agreement. Formation of clinkers in the steam-oxygen gasifier has been a recurring problem which Kellogg submits cannot be dismissed as peculiar only to the pilot plant. Testing at 1800°F or above has generally shown clinkering or sintering. Kellogg recommends that demonstration plant design should avoid the temperature where clinkering occurred in the pilot plant, and that pilot plant experience be coupled with classical fluidization theory to design the steam-oxygen gasifier such that solids mixing is as uniform as possible. In Kellogg's opinion, demonstration plant design using the revised design basis by IGT would have a much greater chance of success, or a much lower overall risk, than would the Procon design. The lowest risk would appear to coincide with the effective utilization of pilot plant experience to the greatest extent possible. (LTN)

16 **(DOE/ET/10324—T43) Engineering support services for the DOE/GRI coal gasification research program. Quarterly technical progress report, July-September 1979.** Cover, A.E.; Bostwick, L.E.; Gunderson, J.M. (Kellogg (M.W.) Co., Houston, TX (USA)). Dec 1981. Contract AC01-78ET10324. 37p. (FE—2778-16). NTIS, PC A03/MF A01. Order Number DE83010968.

Kellogg activities during the third quarter of 1979 included the continued monitoring of test operations at the Hygas, BI-GAS, Westinghouse, Exxon and Rockwell plant sites. Test runs monitored and reported were: Hygas 80, 81 and 82, BI-GAS G-8, G-8A and G-8B, Westinghouse TP-022-2, TP-023-1, Exxon startup activities and Rockwell 318-011 through 318-023. Kellogg continued to monitor design and construction of the Bell Aerospace PDU and the bench-scale and non-integrated PDU activities on peat at the IGT laboratories. Kellogg participated in discussion with DOE and GRI concerning the proposed extension of Kellogg's contract to 31 March 1981. Kellog personnel attended program review meetings at IGT in July, at Rockwell and C.F. Braun in August and at Westinghouse in September. Kellogg continued participation in Metals Properties Council activities. At the request of MPC members, Kellogg prepared a series of recommendations for obtaining data useful for future design of gasification plants. Kellogg personnel attended the semi-annual meeting of MPC Subcommittee 9. Work on the draft report on DOE Task No. 3, Consultation on Westinghouse PDU, has been completed. Work on DOE Task No. 4, PDU Screening Analysis continued with final definitions of process flowsheets and operating conditions. Kellogg continued work on DOE Task No. 5, Safety Assurance Study. Information and data are being gathered on the safety-related aspects of the several processes. Work on DOE Task No. 6, Westinghouse Risk Analysis, has been started.

17 **(DOE/ET/10324—T44) Engineering-support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, January-March 1980.** Bostwick, L.E.; Brancheau, R.J.; Castiglioni, B.P.; Gunderson, J.M.; Hare, R.M.; Hubbard, D.A.; Jacks, J.P.G.; Smith, M.R.; Starr, D.W. (Kellogg (M.W.) Co., Houston, TX (USA)). Dec 1981. Contract AC01-78ET10324. 43p. (FE—2778-24). NTIS, PC A03/MF A01. Order Number DE83010970.

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Kellogg activities during the first quarter of 1980 included the continued monitoring of test operations at the Hygas, BI-GAS, Westinghouse, Exxon, and Rockwell plant sites. Test runs monitored and reported were: Hygas test 85, BI-GAS tests G-11, G-11A, G-11B, Westinghouse test TP-023-4, Exxon test periods 7 through 12, and Rockwell tests 318-044 through 318-062. Kellogg continued to monitor design and construction of the Bell Aerospace PDU, and bench-scale test activities on peat at the IGT laboratories. Kellogg personnel attended the DOE/GRI Operating Committee meeting on 4 March, and program review meetings for Westinghouse, on 1 February, and Rockwell, on 26 March. Kellogg continued their participation in Metals Properties Council activities. On 3-6 March, Mr. S. Sathe attended the 1980 meeting of MPC Phase Group VII, which was held in conjunction with the NACE Corrosion '80 meeting in Chicago. The final report on DOE Task No. 6, Westinghouse Risk Analysis, was issued for approval by the DOE/GRI Operating Committee. Preparation of the final report for the PDU Screening Evaluation (Task No. 4) is underway. Process and estimating work is complete for each of the processes being evaluated. Kellogg continued work on Task No. 5, Safety Assurance Study. Information on the safety-related aspects of each process is still being received and evaluated.

18 **(DOE/ET/10324—T49) Engineering support services for the DOE/GRI coal gasification research program. Quarterly technical progress report for the period January-March 1981.** Bostwick, L.E.; Chen, R.G.; Ethridge, T.R.; Hare, R.M.; Hubbard, D.A.; Senules, E.A.; Singer, D.L.; Smith, M.R.; Shah, K.V. (Kellogg (M.W.) Co., Houston, TX (USA)). Jan 1982. Contract AC01-78ET10324. 37p. (FE—2778-56). NTIS, PC A03/MF A01. Order Number DE83010971.

Kellogg activities during January to March 1981 included continued monitoring of the test operations at the BI-GAS, Westinghouse and Exxon plant sites. Peat gasification laboratory tests were monitored along with modification of Hygas pilot plant for testing of the Peatgas process. Testing at Rockwell ended during June 1980 and testing at Bell was suspended by DOE during July 1980. Pilot plant/PDU test runs monitored and reported were: BI-GAS Tests G-16 and G-16A, Westinghouse test runs TP-M001-1, 2, 3 and 4, Exxon test runs 25, 26 and 27, and single-stage fluidized bed peat gasification tests BF-7 through BF-12. Kellogg continued their participation in Metals Properties Council activities. The final report on the Westinghouse Risk Analysis (Kellogg Task 08) was approved by DOE and is ready for publication. Substantial progress was made on other listed Kellogg tasks. Work continued on subtasks involving Hygas and Peatgas data base evaluations, to incorporate in the draft reports the additional information and comments obtained from IGT.

19 **(DOE/ET/10324—T50) Engineering support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, April-June 1980.** Bostwick, L.E.; Brancheau, R.J.; Chen, R.G. (Kellogg (M.W.) Co., Houston, TX (USA)). 1980. Contract AC01-78ET10324. 36p. (FE—2778-28). NTIS, PC A03/MF A01. Order Number DE83010946.

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Kellogg activities included continued monitoring of test operations at the Hygas, BI-GAS, Westinghouse, Exxon, Rockwell and Bell plant sites, and of peat gasification laboratory activities. Pilot plant/PDU test runs monitored and reported were: Hygas Tests 85 and 86; BI-GAS Tests G-11C, 11D, 11E, 11F, G-12 and G-12A; Westinghouse test runs TP-023-4, TP-027-1, TP-027-2 and TP-027-3; Exxon test periods 13 through 17; and Rockwell Tests 318-063 through 318-073. Kellogg made significant progress toward completion of the Operating Plan Requirements for the individual developers, and began an evaluation of the Hygas data base. The final report on Westinghouse Risk Analysis were issued. Progress was made in completing the reports of the screening evaluations of Exxon, Rockwell and Westinghouse. The safety assurance study continued, as did normal participation in MPC activities. New task orders for technical/economic studies were submitted for review and approval.

20 **(DOE/ET/10324—T52) Engineering-support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, July-September 1981.** Bostwick, L.E.; Ethridge, T.R.; Gilwood, W.C.; Glasgow, P.E.; Hubbard, D.A.; Shah, K.V.; Singer, D.L.; Smith, M.R.; Ward, W.E. (Kellogg (M.W.) Co., Houston, TX (USA)). 1981. Contract AC01-78ET10324. 53p. (FE—2778-65). NTIS, PC A04/MF A01. Order Number DE83011002.

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During July-September 1981 Kellogg continued to actively monitor operations at BI-GAS, Westinghouse and IGT (for peat gasification). Pilot plant/PDU tests which were monitored and reported included BI-GAS Tests G-17D, G-17E, and G-17F; Westinghouse PDU test runs TP-0282 and TP-028-3 and CFSF Tests

TP-M002-2 and TP-M006-1; Peatgas pilot plant Tests # 2 and # 3; and single-stage peat gasification PDU Test BF-21. Work on several task orders was completed with the issue of final reports on technical/economic assessments of Exxon, Westinghouse and Peatgas, the technical/economic comparison of Westinghouse and U-Gas, safety audits, safety assurance, peat harvesting and dewatering, gasifier vessel design and carbonyl formation. Kellogg continued its efforts toward completion of the descriptive brochure for the DOE/GRI Joint program and of the reports on the Hygas and Peatgas data bases. A new subtask, to evaluate the data base for single-stage peat gasification, was undertaken, and Kellogg participated in reviews of the Hygas final report. Normal MPC activities continued.

21 **(DOE/ET/10324—T53) Engineering-support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, April-June 1981.** Bernard, D.M.; Bostwick, L.E.; Ethridge, T.R.; Gilwood, W.C.; Hubbard, D.A.; Montgomery, R.L.; Senules, E.A.; Singer, D.L.; Smith, M.R.; Ward, W.E. (Kellogg (M.W.) Co., Houston, TX (USA)). 1981. Contract AC01-78ET10324. 53p. (FE—2778-60). NTIS, PC A04/MF A01. Order Number DE83011001.

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Kellog activities during April to June 1981 included continued monitoring of activities at Bi-Gas, Westinghouse, Exxon and IGT (for peat gasification). Pilot plant/PDU tests which were monitored and reported include Bi-Gas tests G-16B, G-17, G-17A, G-17B, and G-17C; Westinghouse PDU test runs TP-029-1/030-1, TP-030-2 and TP-028-1 and CFSF tests TP-M002-1 and TP-M002-2; Exxon run period # 28; Peatgas pilot plant Test RF-1 and gasification Test # 1; and IGT single-stage peat gasification PDU Tests BF-13 through BF-20. Significant milestones were reached with the issue of draft reports for several tasks, including carbonyl formation, peat harvesting/dewatering, technical/economic assessments of Exxon, Westinghouse and PeatGas, technical/economic comparison of Westinghouse and U-Gas, gasifier design, safety audits, Hygas data base evaluation and the safety assurance study. In addition, final reports were issued for the Westinghouse oxygen blown gasifier risk analysis and for the PDU screening evaluations of Exxon, Westinghouse and Rockwell. Work on the Peatgas PDU data base evaluation continued, and a review of the Hygas final report was begun.

22 **(DOE/ET/10324—T57) Engineering support services for the DOE/GRI coal-gasification research program. Evaluation of the data base for single-stage gasification of peat.** Bostwick, L.E.; Hubbard, D.A.; Shah, K.V.; Do, L.T. (Kellogg (M.W.) Co., Houston, TX (USA)). Mar 1982. Contract AC01-78ET10324. 54p. (FE—2778-62). NTIS, PC A04/MF A01. Order Number DE83010947.

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Kellogg has reviewed the data base generated by IGT in the 6 inch PDU for the single stage fluidized bed gasification of peat. Kellogg's central finding is that the existing data base should be expanded by further testing in the PDU, after necessary modifications, to investigate further the effects of operating parameters within the ranges of interest. The existing data base consists of 20 PDU runs. Kellogg has concentrated on the Minnesota peat data base, since an insufficient number of runs exist for Maine and North Carolina peats to establish any valid trends. Consequently, the evaluation presented concerns only the Minnesota peat data base with respect to ranges of operating parameters studied, the criteria for good fluidized-bed operation and the effects of the key operating parameters on the performance. In Kellogg's opinion the existing data base demonstrates that: gasification of peat at 90+% carbon conversion is possible in a single stage fluidized bed reactor; the most significant operating parameters have been identified; the single stage fluidized bed peat gasifier has merit because of simplicity of operation, near-zero production of liquids and potential of operation without steam and at low pressure. However, Kellogg notes the following shortcomings:relatively small number of experimental runs and lack of data at certain levels of operating parameters studied; sintering occurred in 35% of the runs; in all the 20 test runs, fines losses exceeded in 5% of the feed and for the Minnesota peat data base, fines losses averaged 12.8%; use of large amounts of fluidizing gas (in this case N_2), which does not reflect commercial operation; and lack of data with higher peat feed moisture content. Thus, in Kellogg's opinion, considerable advantage is to be gained by expanding the existing data base and lists its specific recommendations.

23 **(DOE/ET/10324—T64) Engineering support services for the DOE/GRI coal gasification research program. Final technical progress report, October 1978-November 1982.** Bostwick, L.E. (Kellogg (M.W.) Co., Houston, TX (USA)). 1982. Contract AC01-78ET10324. 216p. (FE—2778-85). NTIS, PC A10/MF A01. Order Number DE83010942.

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The agreement between the United States Government Department of Energy and the Gas Research Institute for the Joint Coal Gasification Research Program provided for one or more technical evaluation contractors. Pullman Kellogg (now the M.W. Kellogg Company) was selected as evaluation contractor to assess, and report to the DOE/GRI Operating Committee on, the relative merits of the active programs covered by the agreement. This report includes the period from 1 October 1978 to 30 November 1982. The objective was to provide engineering support for the DOE/GRI high Btu coal gasification program. This support generally consisted of assistance in developing or advancing each process to its maximum potential. Kellogg monitored and evaluated the startup and operational activities of all pilot plant projects within the combined DOE/GRI program. Kellogg evaluated proposals to determine their technical feasibility as potential processes or as viable processing operations for commercial-scale gasification of coal. Kellogg also recorded observations on the reliability, maintainability, and availability of the equipment used in the pilot plant or PDU facilities. Kellogg performed design reviews, data analyses, and engineering evaluations of proposals, cost estimates and monthly progress reports to provide information considered essential to the overall objectives of the combined DOE/GRI program.

24 **(DOE/ET/10324—T66) Engineering support services for the DOE/GRI coal-gasification research program. Quarterly technical progress report, July-September 1982.** Bostwick, L.E.; Ethridge, T.R.; Starr, D.W.; Koneru, P.B.; Hubbard, D.A.; Shah, K.V.; Smith, M.R.; Ward, W.E.; Wong, E.W. (Kellogg (M.W.) Co., Houston, TX (USA)). 1982. Contract AC01-78ET10324. 18p. (FE—2778-81). NTIS, PC A02/MF A01. Order Number DE83010944.

Pilot Plant and Process Development Unit Monitoring continued through August 1982; thereafter, such activities (and also MPC participation) were terminated in accordance with contract modifications. Testing monitored included PDU test run IP-033-1 and CFSF Tests TP-M005 and TP-M007-1 at Westinghouse, and wet carbonization PDU Test PB-5 at IGY. A draft report of the Westinghouse CFSF was issued for approval. Work on the descriptive brochure of the DOE/GRI Joint Program is nearly complete.

25 **(DOE/MC/14361—1495) Fluidized-bed gasifier/systems model development. Final report, September 30, 1981-September 30, 1982.** Piperopoulou, H.; Bloomfield, D.; Finson, M. (Physical Sciences, Inc., Andover, MA (USA)). Oct 1982. Contract AC21-80MC14361. 106p. (PSI-TR—354). NTIS, PC A06/MF A01. Order Number DE84002273.

This report describes the work performed by Physical Sciences Inc. (PSI) in the development of a Fluidized Bed Coal Gasifier/Systems Model. The program was performed in two tasks. The first task is concerned with the modification of the existing PSI/FLUBED code to account for the possibility of slug flow in the gasifier. Work previously performed under the present contract indicated that the Westinghouse PDU gasifier operated in the slug flow regime. Prior to this time the PSI/FLUBED code modeled ebullating beds only. The second task performed under this contract has been concerned with the development of a systems model which simulates the operation of a commercial scale Westinhouse Fluidized Bed Coal Gasifier. The systems model is based on the output of 33 reference states developed by running the PSI/FLUBED code. Under this task, the systems model was developed along with two supporting codes for checkout and data file preparation. The data from the PSI/FLUBED code was reviewed and 180 Taylor series expansion coefficients were generated. In addition

the PSI/FLUBED code was modified to handle gasifiers whose diameter varies discontinuously with height. An interface driver was also developed which streamlines the operation of the PSI/FLUBED code making it more user friendly. All codes developed under the contract have been verified and are operational. 14 references, 4 figures, 9 tables.

26 **(DOE/MC/14385—1484) Thermal and catalytic cracking of tars and tar constituents from coal-gasification processes. Final report.** Wen, W.Y. (Clark Univ., Worcester, MA (USA). Dept. of Chemistry). Oct 1983. Contract AC21-80MC14385. 77p. NTIS, PC A05/MF A01. Order Number DE84002012.

The objective of this program is to screen catalysts and determine operating conditions for maximizing gas and char production from the pyrolysis of coal gasification tars. The product yields from cracking a bituminous coal tar in a fixed-bed reactor were determined at various temperatures in the presence and absence of some packing materials. Synthetic zeolites, Linde LZ-Y82, Norton Zeolon 900-H (mordenite), Davison 13-X, and ultra-stable faujasite (H-Y), as well as a natural zeolite, chabazite, showed strong catalytic activity. In contrast, molecular sieves 5-A and natural erionite having smaller pore diameters were found to be much less active. Clay minerals such as kaolinite, montmorillonite and Kieselguhr exhibited catalytic activities which were similar to those of the zeolites with small pore sizes, but they were still far more effective than quartz particles. Based on the assumption of first-order kinetics, the activation energies for the tar conversion were evaluated for several packing materials. It was found that the zeolite LZ-Y82 was remarkably effective in converting tar to chars and gases in the temperature range of 350 to 500°C, although this effectiveness decreased very rapidly with a continuous tar feed carried by an inert gas. Among the factors involved for catalytic effectiveness are (1) the effective pore size greater than about 0.7 nm (or 7A), (2) large internal surface area accessible to the tar vapor, and (3) large number of strongly acidic sites. 22 references, 6 figures, 22 tables.

27 **(DOE/MC/19163—T9) ASPEN physical property evaluation for Great Plains simulation. Great Plains ASPEN model development.** Millman, M.C. (Scientific Design Co., Inc., New York (USA)). 4 Aug 1983. Contract AC21-82MC19163. 163p. NTIS, PC A08/MF A01. Order Number DE83017799.

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This report documents the steps taken to evaluate the pure component properties in the ASPEN data bank for those compounds required to simulate the Great Plains Coal Gasification Plant where the compounds are also available in the DIPPR (Design Institute for Physical Property Data) data bank. DIPPR is a cooperative effort of industry, institutes and federal agencies interested in the compilation, measurement and evaluation of physical property data for industrially important compounds. It has been found that the ASPEN data bank is for the most part reliable, its main problem being lack of documentation. In the few instances where values were found to be either missing or to be unacceptable, recommended constants or equation parameters are presented in this report along with associated literature citations. In the cases where temperature dependent data were regressed to obtain new equation parameters, the detailed methods employed are also presented.

28 **(DOE/PC/30021—T13) Catalyst and reactor development for a liquid-phase Fischer-Tropsch process. Quarterly technical progress report, 1 January 1983-31 March 1983.** Dyer, P.N.; Pierantozzi, R.; Brian, B.W.; Nordquist, A.F.; Parsons, R.L. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Sep 1983. Contract AC22-80PC30021. 58p. NTIS, PC A04/MF A01. Order Number DE84001069.

Two major tasks continued in the APCI/US DOE contract, Catalysts and Reactor Development for a Liquid Phase Fischer-Tropsch Process: (1) Slurry Catalyst Development; and (2) Slurry Reactor Design Studies. The first extended slurry test was continued using a proprietary catalyst. The results showed that it was possible to produce yields in the diesel fuel region equal to or greater than the Schulz-Flory maximum, without further optimization. Low deactivation rates were observed. Kinetic rate constants were derived from the CSTR experiments, and used in a computer simulation to predict conversions from bubble column operation under Rheinpreussen conditions. Short term (21 day) slurry tests were carried out on two other catalysts, optimized by the screening program. Parametric gas phase screening results were concluded for two additional modified conventional catalysts, and the optimum preparation and activation methods for diesel fuel selectively were chosen. In the hydrodynamic studies, work in the 5″ column was completed with measurements on the Fe_2O_3/water slurries. In the 12″ column, fitted with 7 heat transfer tubes, hydrodynamic parameters were determined for slurries of Fe_2O_3 in paraffin and water, and SiO_2 in water. Gas holdups were close to the Akita and Yoshida correlation for the hydrocarbon slurries, but lower for the aqueous ones. Solid concentration profiles, modelled by the sedimentation model, gave evidence of particle agglomeration in SiO_2/hydrocarbon slurries, underlining the need to use chemically similar slurries in cold-flow modelling work. In the 5″ column, solid and liquid dispersion coefficients were found to be equal.

29 **(DOE/PC/30232—T7) Pollutants from coal conversion processes. Seventh progress report, March 1, 1983-May 31, 1983.** Ferrell, J.K.; Felder, R.M. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). 1983. Contract FG22-80PC30232. 7p. NTIS, PC A02/MF A01. Order Number DE84001856.

A brief summary of progress achieved during the quarter ending May 31, 1983 is presented. Asymptotic weight loss data for flash pyrolysis of subbituminous coal are presented. Comparisons are made between weight loss versus temperature for flash and slow pyrolysis. The yield of sulfur gas species increased monotonically with temperature, with hydrogen sulfide being the major sulfur species involved. 4 figures. (DMC)

30 **(DOE/PC/40782—T6) Desulfurization with transition-metal catalysts.** Eisch, J.J. (State Univ. of New York, Binghamton (USA). Dept. of Chemistry). 1 Oct 1983. Contract FG22-81PC40782. 5p. NTIS, PC A02/MF A01. Order Number DE84000628.

The principal objective of this research is to uncover new reagents and catalysts for upgrading coal-derived fuels by removing undesirable organosulfur, organonitrogen and, if feasible, oxygen components. The studies in progress are: (1) evaluation of the desulfurization by reduced nuckel salts deposited on a solid support and used in percolation columns; (2) comparing the efficiencies of metal salts (Ni, Co, Cu and Mo), types of solid support (Al_2O_3, SiO_2, organic polymers) and operating temperatures; and (3) completing preliminary attempts to carry this procedure over to the denitrogenation of model compounds and SRC liquids. The following progress have been made: (1) reduced nickel supported on columns of alumina or poly-4-vinylpyridine and heated at 75°C has been found to remove up to 80% of the sulfur from SRC liquids; (2) cobalt reagents have been found to be almost as effective, but copper and molybdenum have proved less efficient; (3) combinations of lithium and titanium salts have shown promise in cleaving C-N bonds in model compounds of the carbazole type; and (4) nickel supported on alumina not only removes much of the sulfur from SRC liquids, but has also been shown to reduce the nitrogen content from 0.91% to 0.01%.

31 **(DOE/PC/40800—T3) Supercritical fluids for reaction and extraction of coal and heavy oils. Final report, September 1, 1981-September 1, 1983.** Holder, G.D.; Gopal, J.; Deshpande, G.V. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Sep 1983. Contract FG22-81PC40800. 78p. NTIS, PC A05/MF A01. Order Number DE84001046.

A study of supercritical extraction includes extraction/reaction of different ranks of coals using water and organic solvents under supercritical conditions, and study of solubility of mixtures of model compounds in a supercritical fluid. Emphasis has been placed on developing a fundamental understanding of supercritical phenomena and on the potential for utilizing supercritical extraction for coal conversion and coal deashing. Batch experiments in a 1 litre autoclave with different types of coals and solvents are reported. Experiments were conducted initially with glucose as the substrate

to duplicate results in the literature. Systems studied are represented by various combinations of: glucose-water, German brown coal-toluene, and Bruceton bituminous coal-piperidine. The effect of time of extraction, supercritical phase density, temperature, pressure, coal rank and stirrer speed on the extent of conversion of coal to liquids and gases have been studied. The experiments lead to the following conclusions: (1) injection of coal under supercritical conditions results in better conversion and less char than when coal is present during the heat-up period; (2) THF insolubles are considerably decreased when higher supercritical phase densities are used; (3) conversions approach equilibrium with increase in reaction times to one hour; (4) experiments with various solvents indicate that a minimum temperature (about 370°C) has to be reached to achieve appreciable conversion; (5) the acidity of the extracted product is high when water is used as the solvent and high sulfur coal as the substrate. It may be attributed to dissolved H_2S. Apparently water, under supercritical conditions, is leashing out some of the inorganic material in ash; and (6) an increase in stirrer speed from 500 to 2500 rpm resulted in lower THF insolubles. Apparently, a speed of 500 rpm is insufficient to keep the coal in suspension.

32 **(DOE/PC/50046—4) Unit-operation performance, Fort Lewis pilot plant. Report for the Technical Data Analysis Program.** (Pittsburg and Midway Coal Mining Co., Denver, CO (USA)). 1983. Contract AC22-82PC50046. 68p. NTIS, PC A04/MF A01. Order Number DE84001829.

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This report reviews the operating performance of selected areas of the Fort Lewis, Washington Solvent Refined Coal (SRC) Pilot Plant. This facility was operated by The Pittsburg and Midway Coal Mining Co. for the US Department of Energy. Initial operations began in late 1974 and continued until mid-1981. Performance of the following equipment areas are included in this review: (1) coal receiving and slurry preparation; (2) reaction area; (3) fractionation area; and (4) slurry flow measurement. Operating problems and modifications that were made to eliminate or minimize the problems are discussed. In some cases, recommendations are offered for consideration in future plant designs.

33 **(DOE/PC/50787—T2) Coal extraction by supersolvents, November 1, 1982-January 31, 1983.** Sears, J.T. (Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering). 1983. Contract FG22-82PC50787. 9p. NTIS, PC A02/MF A01. Order Number DE83013577.

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Screening runs were conducted with a high volatile bituminous PSOC 323 and PSOC 314 coals. These coals were subjected to tetramethyl urea (TMU), TUM/HMPA (hexamethylphosphoramide) and TMU/tetralin to examine the effects of solvent mixtures. The runs were conducted generally in batch for 20 minutes; then the samples were filtered and the residue washed in water or acetone. The residue was stored in a dessicator and pumped. Weight was taken at various times up to 10 days after initial dissolution. The liquid filtrate was analyzed by C^{13} NMR and mass-spectrometry. The residue was ashed to examine ash content for potential differences. The data shows swelling and dissolution being dependent on temperature and coal seam. The spectra indicate large aromatic species, which could come from either solvent or thermolytic action. 5 figures, 2 tables.

34 **(DOE/PC/60813—1) Hydrotreatment catalyst activity enhancement. Quarterly report No. 1, August 1-October 31, 1983.** Seapan, M.; Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1 Nov 1983. Contract FG22-83PC60813. 9p. NTIS, PC A02/MF A01. Order Number DE84001828.

Preliminary studies have been conducted to identify a low coking and a high coking model hydrocarbon compound. Reactor selection has been completed, and it was decided to use both a trickle bed and a gradientless reactor in this project. First series of experiments will be conducted during the next reporting period. 8 references, 1 table.

35 **(DOE/RA/50356—1308-Vol.1) New Mexico synfuels project. Coal-liquid fuels and high-Btu coal gas. Volume I. Executive summary.** (Texas Eastern Synfuels, Inc., Houston (USA); Utah International, Inc., San Francisco, CA (USA)). Oct 1982. Contract FG01-81RA50356. 94p. NTIS, PC A05/MF A01. Order Number DE84001654.

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The New Mexico Synfuels Project is technically feasible to construct and operate. No major environmental issues have been identified that would cause significant adverse impacts in the region. Socioeconomic conditions existing in the region of the plant are conducive to a project of this type. Federal and state authorities have been kept advised of the progress of the project and have been encouraging in their assistance. A suitable plant site and the basic input resources of coal and water are available. There is limited market potential for the plant products. With the exception of carbon dioxide, revenues derived from sales of the by-products do not contribute significantly to support of the plant. Of the two primary products, SNG has potential markets in Southern California and the Gulf Coast but suffers a price disadvantage relative to conventional supplies in both areas. Methanol has possible uses as a utility or turbine fuel, particularly in Southern California where power companies have expressed an interest in methanol for peaking purposes. A base load demand, however, is necessary for the development of a substantial market and at this time is not anticipated as developing unless additional environmental constraints are imposed on emissions. If carbon dioxide produced by the plant could be marketed to West Texas enhanced oil recovery projects, it would contribute significantly to the economics. The economic viability of the project as proposed is marginal. Estimated market prices for the plant products do not appear to be sufficient to achieve an acceptable rate of return on investment to the project sponsors. Some means of financial assistance, preferably in the form of loan guarantees and price supports, will be necessary if the project is to proceed.

36 **(DOE/RA/50356—1308-Vol.2) New Mexico Synfuels Project: coal-liquid fuels and high-Btu coal gas. Feasibility study. Volume II. Plant site, resources, and waste disposal.** (Texas Eastern Synfuels, Inc., Houston (USA); Utah International, Inc., San Francisco, CA (USA)). Oct 1982. Contract FG01-81RA50356. 215p. NTIS, PC A10/MF A01. Order Number DE84001657.

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Volume 2 considers site selection in detail and compares the advantages and disadvantages of 5 potential sites. Coal requirements for the plant are determined and the availability of coal resources, transport methods and materials handling and coal preparation are considered, including potential environmental and permitting constraints. Next, the water requirements are evaluated and then, the availability of water supply (including pumps, pipelines and reservoirs needed). Solid waste disposal methods (for hazardous and non-hazardous wastes) are evaluated (including permitting constraints). (LTN)

37 **(DOE/RA/50356—1308-Vol.3) New Mexico Synfuels Project: coal-liquid fuels and high-Btu coal gas. Feasibility study. Volume III. Plant design.** (Texas Eastern Synfuels, Inc., Houston (USA); Utah International, Inc., San Francisco, CA (USA)). Oct 1982. Contract FG01-81RA50356. 539p. NTIS, PC A23/MF A01. Order Number DE84001660.

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A data base has been established to permit preparation of the scope and estimation of the cost of a coal gasification facility. The proposed plant would gasify New Mexico coal to produce methanol and synthetic natural gas (SNG), the quantities of the two fuel products being approximately equal in terms of heat of combustion. Marketable by-products will also be produced. Process technology from gasification of the coal through manufacturing the main fuel products was supplied by the Lurgi Corporation, Eastern Division. Information related to auxiliary units was supplied either from qualified licensors, or was derived from Bechtel in-house data. Note also that the facility has been designed in accordance with appropriate local and federal regulations in effect as of June, 1982. The

data, information, bases and assumptions used in carrying out the technical and cost studies are presented. The general design philosophy was to minimize any risks and uncertainties associated with a coal gasification facility, while developing capital and operating costs sufficient to decide whether to proceed with the project after the feasibility study. In addition, the philosophy was to make selections of alternatives that provided the maximum amount of cost information for use in evaluating plant configurations and size.

38 **(DOE/RA/50356—1308-Vol.4A) New Mexico Synfuels Project: coal-liquid fuels and high-Btu boal gas. Feasibility study. Volume IV A. Environmental.** (Texas Eastern Synfuels, Inc., Houston (USA); Utah International, Inc., San Francisco, CA (USA)). Oct 1982. Contract FG01-81RA50356. 288p. NTIS, PC A13/MF A01. Order Number DE84001656.

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Volume 4A is essentially the geology, hydrology, topography and baseline ecology of the site. Along with this, possible federal and state standards, constraints and permit applications and the authorities involved in each case are considered (a total of 24 regulations, laws and/or authorities). Finally, the impacts of the proposed plant are discussed in relation to these constraints and the strategy to be involved in getting the permits. (LTN)

39 **(DOE/RA/50356—1308-Vol.4B) New Mexico Synfuels Project: coal-liquid fuels and high-Btu coal gasgas. Feasibility study. Volume IV B. Environmental.** (Texas Eastern Synfuels, Inc., Houston (USA); Utah International, Inc., San Francisco, CA (USA)). Oct 1982. Contract FG01-81RA50356. 476p. NTIS, PC A21/MF A01. Order Number DE84001659.

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Volume IV B considers archaeological and cultural resources, socio-economic conditions in the area and how they might be affected, health hazards associated with the plant and related pollution control and safety engineering. (LTN)

40 **(DOE/RA/50356—1308-Vol.5) New Mexico Synfuels Project: coal-liquid fuels and high-Btu coal gas. Feasibility study. Volume V. Project development.** (Texas Eastern Synfuels, Inc., Houston (USA); Utah International, Inc., San Francisco, CA (USA)). Oct 1982. Contract FG01-81RA50356. 256p. NTIS, PC A12/MF A01. Order Number DE84001658.

Volume 5 discusses the management philosophy of this project, management organization, etc. (few multi-skilled people rather than specialists); marketing research done for products and by-products, capitalized and operating cost of the proposed plant; the use of coal fines (not usable in the Lurgi process); sensitivity analysis; and financing considerations (possibly SFC).

41 **(DOE/RA/50393—T1-Vol.1) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 1. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 351p. NTIS, PC A16/MF A01. Order Number DE84001120.

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Hampshire Energy and its subcontractors have performed a feasibility study of a plant to produce 20,000 barrels of gasoline per day from coal at a site near Gillette, Wyoming. The study, completed during May 1982, was partially funded by the United States Department of Energy (DOE) Feasibility Study Grant DE-FG01-81RA50393, dated January 19, 1981. Presented herein are the items deliverable to the DOE under the terms of that grant. The DOE data classification numbers correlate to the report sections as follows: 10, Section 1; 117, Sections 2, 3 and 4; 118, Sections 5 and 6; 11, Sections 7, 8, 9, 10 and 11; 1110, Section 12; and 119, Section 13.

42 **(DOE/RA/50393—T1-Vol.2) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 2. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 610p. NTIS, PC A99/MF A01. Order Number DE84001161.

43 **(DOE/RA/50393—T1-Vol.3) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 3. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 533p. NTIS, PC A23/MF A01. Order Number DE84001162.

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44 **(DOE/RA/50393—T1-Vol.4) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 4. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 383p. NTIS, PC A17/MF A01. Order Number DE84001163.

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45 **(DOE/RA/50393—T1-Vol.5) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 5. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 344p. NTIS, PC A15/MF A01. Order Number DE84001164.

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This report was prepared in support of the Hampshire Energy Project construction permit application filed with the Air Quality Division of the State of Wyoming Department of Environmental Quality in January, 1982. This report presents a detailed description of the proposed facility and a quantification of its atmospheric emissions. Also discussed is Best Available Control Technology which will minimize the atmospheric emissions. The facility's impact on ambient air quality was determined through comprehensive atmospheric dispersion modeling analyses that considered facility emissions as well as other existing and proposed emission sources in the Gillette area. Facility impacts on visibility, soils and vegetation was also analyzed. The Hampshire Energy facility will be designed to comply with New Source Performance Standards through the application of Best Available Control Technology and other emission controls. As a result, the facility emissions will be low. In fact, the facility's emissions of particulate matter, sulfur dioxide and nitrogen oxides will be much lower than the emissions that would result if the same amount of coal were to be burned in a power plant. Hampshire Energy conducted a detailed one-year monitoring program of ambient air quality and meteorology at the Hampshire Energy Project site. The program was in full compliance with applicable rules and regulations for Prevention of Significant Deterioration monitoring.

46 **(DOE/RA/50393—T1-Vol.6) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 6. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 407p. NTIS, PC A18/MF A01. Order Number DE84001165.

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47 **(DOE/RA/50393—T1-Vol.7) Plant to produce 20,000 barrels per day of gasoline from coal. Volume 7. Final report.** (Hampshire Energy, Gillette, WY (USA)). May 1982. Contract FG01-81RA50393. 1578p. NTIS, PC A99/MF A01. Order Number DE84001166.

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48 **(ICTIS/M—0165) Liquefaction via solvent extraction of Magallanes coal.** Bargellini, F.; Noriega, G.; Perez de Arce, E. (Instituto Mexicano de Investigaciones Siderurgicas, Saltillo). 1981. 16p. (In Spanish). (CONF-8109202—). Instituto Mexicano de Investigaciones Siderurgicas, Saltillo.

From 1. international symposium on coal; Ixtapa, Mexico (7 Sep 1981).

The paper describes a liquefaction process via solvent extraction, using synthesis gas (CO and H_2). Results are presented using coal of sub-bituminous rank BC1 from the Magallanes coalfield in Southern Chile. The first stage, reproduced the successful experimental conditions applied in the University of North Dakota's Solvent-Refined Lignite process using North Dakota lignite. Stage 2 investigated the effects of an increase in temperature. Stage 3 used the same experimental conditions as the first stage, but used pure H_2 instead of synthesis gas. It is concluded that Magallanes coal is suitable for the intended processes, giving a high conversion

rate and yield of liquids. (3 refs.) (Available from IEA Coal Research, quoting ICTIS/M0165)

49 **(N—8321054) Enlargement of the raw material basis of refineries by including hard coal: Pilot plant for coal hydrogenation, construction phase. Final Report, Apr. 1982.** Lodes, R.; Lohr, B.; Oleownik, A.; Reifarth, K. (Saarbergwerke A.G., Saarbruecken (Germany, F.R.)). Nov 1982. 58p. (MIXED). NTIS, PC A04/MF A01.

The design, construction and commissioning of a pilot plant for direct coal hydrogenation with a maximum coal throughput of 6 t/d is discussed. This plant is based on the proven IG-process. The design data for the modified process was experimentally obtained during laboratory scale investigations, including newly introduced process steps.

50 **Gasification system.** Haldipur, G.B.; Anderson, R.G.; Cherish, P. (to US Dept. of Energy). US Patent 4,391,611. 5 Jul 1983. Filed date 5 Mar 1981. vp.
PAT-APPL-240654.

A method and system is disclosed for injecting coal and process fluids into a fluidized bed gasification reactor. Three concentric tubes extend vertically upward into the fluidized bed. Coal particulates in a transport gas are injected through an inner tube, and an oxygen rich mixture of oxygen and steam are injected through an inner annulus about the inner tube. A gaseous medium relatively lean in oxygen content, such as steam, is injected through an annulus surrounding the inner annulus.

51 **A versatile phase equilibrium equation of state.** Mathlas, P.M. (Energy Laboratory and Chemical Engineering Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Industrial and Engineering Chemistry Process Design and Development;* **22**: No. 3, 385-390(Jul 1983).

The Soave modification of the Redlich-Kwong equation has been very effective for correlating the phase equilibrium of systems containing nonpolar and slightly polar substances. In this work further modifications are introduced which retain the simplicity and robustness of the Soave equation but extend its application to systems containing highly polar substances such as water. Applications shown in the work include systems of interest in coal processing and some common systems containing water.

52 **Simple field test model for underground coal gasification.** Galli, R.D.; Jones, G.E.; Kiviat, F.E. (Gulf Research & Development Company, Pittsburgh, Pennsylvania 15230). *Industrial and Engineering Chemistry Process Design and Development;* **22**: No. 3, 538-544(Jul 1983). Contract AC20-77ET13108.

A simple process model was used to study the effects certain variables had on the product gas composition from a subbituminous, steeply dipping underground coal gasification field test. The authors found that two key model input parameters were (1) heat loss and (2) the ratio CO/CO_2 in the carbon oxidation equation. An increase in the heat loss parameter was generally accompanied by a decrease in the CO/CO_2 parameter in order to fit the field test data. The heat loss parameter increased as the field test progressed, suggesting increased rock fall or ground water influx. Very late in the field test, the only way to fit the data was by substituting a "fictional" coal having a high char/volatile ratio. The authors conclude that as the process module aged, the production of char (relative to volatiles) increased.

53 **Coal gasification using solar energy.** Mathur, V.K.; Breault, R.W.; Lakhmanan, S. (Department of Chemical Engineering, University of New Hampshire, Durham, NH 03824). *Solar Energy;* **30**: No. 5, 433-440(May 1983). Contract AC02-79ET21067.

A Gas Recirculation Solar Hybrid Technique developed at the University of New Hampshire for the gasification of carbonaceous materials using solar energy is discussed. The cost of substitute natural gas (SNG) manufactured from conventional and hybrid units of 7.08×10^6 m³ per day (250 MM SCF/D) capacity from various feed stocks has been computed and compared. It is estimated that by 1995 the cost of SNG from a hybrid system will be competitive with conventional gasification systems. The size of the hybrid plant versus gas cost has also been studied and it is found that for plants smaller than 0.566×10^6 m³ per day (20 MM SCF/D) of SNG, the gas cost increases exponentially. A bench scale unit of the UNH Gas Recirculation System for coal carbonization has been tested using an electric heater to simulate solar energy with nitrogen as the heat carrier gas. This study shows the successful carbonization of coal by indirectly transferring simulated solar heat, using the gas recirculation technique. The products obtained are similar to those from a conventional carbonization unit. Results obtained so far show the UNH Gas Recirculation Solar Hybrid process is economically and technically feasible.

54 **An overview of coal-fed systems.** Gall, R.L.; Johnson, E.K. (US Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV 26506). *Chemical Engineering Progress;* **79**: No. 5, 31-36(May 1983).

This article explains how the recent development of modified coal-feeder concepts may resolve the serious problems of efficiently feeding coal to, and removing the solid refuse from, the reactor. The development of a new generation of coal-feed systems is critical to the success of modern gasification, liquefaction, and fluidized-bed boiler programs. New processes and advanced systems are needed to utilize the vast reserves of available coal to produce economic synthetic fuels or to produce steam in an environmentally acceptable manner. Due to the lack of a full-scale test facility for new coal feeders, the final steps in development and acceptance must be postponed for many of the new concepts described in this article.

55 **Thermal-shock damage of refractories for application in slagging coal gasifiers.** Bandyopadhyay, G.; Chen, J.; Diercks, D.R.; Kennedy, C.R. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, IL 60439). *Journal of Materials for Energy Systems;* **4**: No. 4, 234-240(Mar 1983).

Several commercial high-Cr_2O_3 refractories (containing 60 to 90 wt pct Cr_2O_3) with potential for application in slagging gasifiers were evaluated for thermal-shock resistance by means of water-quench tests. The results show that the high-Cr_2O_3 refractories are considerably more susceptible to thermal-shock damage than the commercially available 90 pct Al_2O_3-10 pct Cr_2O_3 refractories. High-Al_2O_3 refractories, however, may undergo catastrophic corrosion under slagging conditions. The calculated R"" and R /SUB st/ values for the test refractories indicate that R"" provides a good measure of thermal-shock-damage resistance of the refractories; R /SUB st/ , on the other hand, did not show any systematic correlation, probably owing to the limited amount of data currently available.

56 **Combustion of coal gas fuels in a staged combustor.** Rosjford, T.J.; Mcvey, J.B.; Schultz, D.F.; Senderquist, R.A. (United Technologies Research Center, United Technologies Corporation, East Hartford, Connecticut). *American Society of Mechanical Engineers, [Paper];* **83-GT-108**: 10(1983). (CONF-830309—).

From 28. ASME international gas turbine conference; Phoenix, AZ, USA (27 Mar 1983).

Gaseous fuels produced from coal resources have been considered for use in industrial gas turbines. Such fuels generally have heating values much lower than the typical gaseous fuel, natural gas; the low heating value could result in unstable or inefficient combustion. Additionally, coal gas fuels may contain ammonia which, if oxidized in an uncontrolled manner, could result in unacceptable NO /SUB x/ exhaust emission levels. Previous investigations have indicated that staged, rich-lean combustion represents a desirable approach to achieve stable, efficient, low NO /SUB x/ emission operation for coal-derived liquid fuels containing up to 0.8-wt pct nitrogen. An experimental program has been conducted to determine whether this fuel tolerance can be extended to include coalderived gaseous fuels. The results of tests with three nitrogen-free fuels having heating values of 100, 250, and 350 Btu/scf and a 250 Btu/scf heating value doped to contain 0.7 pct ammonia are presented.

57 **(N—8321051) Desulphurisation of solid fuels in power stations by superconductive magnets.** Doerr, H.; Monostory, F.P.; Seidl, M. Translated from *Glueckauf*; 117: No. 17a, 11-17(1981). 21p. Avail: British Library Lending Div., Boston Spa, Engl.

Desulphurization of solid fuels in power station by superconductive magnets was studied. A superconductive strong field magnetic separator was integrated in the inner grinding circuit of a coal mill as a dry process for the physical mineral and pyrite separation from power station coal. Further development work is required to make the process suitable for customary plant sizes. The process cannot replace, but only assist desulphurization of the flue gases in the case of coal with over 0.6% organic sulphur/t ce even with an emission value of 3.75 kg SO_2/MWh. Depending on the sulfur or pyrite content of the power station coal supplied, the efficiency and costs of flue gas desulphurization and the limit value of the permissible SO2 emission, the combination of pulverized coal and flue gas desulphurization may be economically advantageous in limiting cases.

0105 By-products

REFER ALSO TO CITATION(S) 26, 84

58 **(EUR—8064-Vol.2-d) Investigation of the trickling behaviour of sinter and pellets through layers of lump and formed coke (Report on ECSC contract 6210-AA/1/102).** Jeschar, R.; Landsberg, R.; Poettke, W. (Commission of the European Communities, Luxembourg). 1983. 83p. Commission of the European Communities, Luxembourg.

Pressure drop measurements were carried out in a loosely packed column which was initially stationary and later moving. Materials used in the column included lump coke, formed coke pellets, sinter, lump ore and mixtures thereof. The materials were classified into 3 categories. Materials with a rough surface and irregular shape (e.g. coke) increased the volume of voids during their descent and the pressure drop was reduced. The mixing processes in materials charged in layers were also investigated. All the experiments showed that the trickling of pellets and sinter into the coke layer could not be avoided.

0106 Properties

REFER ALSO TO CITATION(S) 31, 107, 108, 112, 246, 880, 1398

59 **(ACIRL-PR—82-8) Coke strength prediction methods applied to Australian coals.** Roberts, O.C. (Australian Coal Industry Research Labs. Ltd., North Ryde). Oct 1982. 22p. Australian Coal Industry Research Labs. Ltd., North Ryde.

Well-known prediction methods based upon petrographic analysis and dilatometry are examined with respect to coke strength data for a representative group of Australian coals coked in the Australian Coal Industry Research Laboratories Ltd. (ACIRL) moveable wall test oven under standard conditions. It is concluded that petrographic data alone are insufficient for accurate prediction of coke strength of Australian coals, while the G-factor prediction method which takes cognisance of carbonising conditions also predicts poorly for Australian coals. Simple second degree regression equations in rank and type variables are capable of better accuracy than the well-known methods examined.

60 **(ANL/FE—83-19) Computer-assisted analyses of the thermodynamic properties of slags in coal-combustion systems.** Blander, M.; Pelton, A.D. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 77p. NTIS, PC A05/MF A01. Order Number DE84002682.

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Equations were developed for the analysis of the thermodynamic properties of molten silicate solutions; the equations take into account the unusual concentration and temperature dependence of the solution properties of ordered systems. For binary systems, these equations were coupled with an optimization computer program to analyze all reliable thermodynamic data, including phase diagrams, free energies and enthalpies of formation of compounds, activities of components, enthalpies of mixing, entropies of fusion, miscibility gaps, etc. In this manner, we analyzed data for five binary systems: $CaO-SiO_2$, Na_2O-SiO_2, $CaO-Al_2O_3$, $Na_2O-Al_2O_3$, and $Al_2O_3-SiO_2$. The results of the binary systems were combined, and an analysis done of three ternary systems: $CaO-Al_2O_3-SiO_2$, $Na_2O-CaO-SiO_2$, and $Na_2O-Al_2O^3-SiO_2$. A tentative analysis of the quaternary system, $Na_2O-CaO-Al_2O_3-SiO_2$, was also undertaken. 53 references, 51 figures, 3 tables.

61 **(DOE/ER/10483—T1) Determination of fundamental thermochemical and kinetic data for radical species important in coal conversion. Annual progress report, 1 January-31 December 1982.** McMillen, D.F.; Rossi, M.J.; Ogier, W.C.; Golden, D.M. (SRI International, Menlo Park, CA (USA). Chemical Kinetics Dept.). 7 Oct 1983. Contract AC03-79ER10483. 58p. NTIS, PC A04/MF A01. Order Number DE84001589.

Very low-pressure pyrolysis (VLPP) measurements of unimolecular bond cleavage in 9,9-dimethyl-9,10-dihydroanthracene have provided a bond dissociation energy (bDE) for the 9-H bond in the parent hydrocarbon of 76.2 kcal mol^{-1} and a heat of formation for the 9-hydroanthryl radical of 62.3 kcal mol^{-1}. These values represent the first experimental gas-phase values for any higher homologues of cyclohexadienyl radical. They also illustrate the need for further measurements of cyclohexadienyl radical stability by another technique. Attempts to avoid this limitation by using the VLPP system to measure an equilibrium constant for the addition of methyl radical to anthracene were unsuccessful; the rapid addition of a second methyl radical makes the dynamic range requirements for determining the equilibrium constant for the initial addition process very stringent. VLPP measurements of C-C and C-H bond scission rates in diphenylmethane, 2-benzylpyridine, and 4-benzylpyridine provide temperature-dependent rate constants for all eight C-C and C-H bond homolysis that are compatible with A-factors of $10^{15\ 3\ +-\ 0\ 5}\ s^{-1}$, in contrast to recent reports that benzylic C-H bond homolysis exhibit much higher A-factors. The heat of formation of the diphenylmethyl radical derived from these C-H scission rates is 69.0 kcal mol^{-1}, in excellent agreement with studies involving diphenylmethyl radical formation by C-C bond scission. This heat of formation corresponds to an extra stabilization in diphenylmethyl radical (compared to α-phenylethyl radical) of $\sim$ 4 kcal mol^{-1}. Appendix A has been entered individually into EDB and ERA.

62 (DOE/ER/10483—T1, pp vp, Appendix A) **Aliphatic C-H bond scission processes in diphenylmethane, 2-benzyl-, and 4-benzylpyridine: the heat of formation of the diphenylmethyl and α-phenylethyl radical in the gas phase.** Rossi, M.J.; McMillen, D.F.; Golden, D.M. (SRI International, Menlo Park, CA). 7 Oct 1983. NTIS, PC A04/MF A01. Contract AC03-79ER10483.

In Determination of fundamental thermochemical and kinetic data for radical species important in coal conversion. Annual progress report, 1 January-31 December 1982.

Very low pressure pyrolysis (VLPP) of the title compounds indicates both C-C and C-H bond rupture. Rate constants for all six processes are compatible with A-factors of $10^{15\ 3}\ s^{-1}$ and activation energies of 81.4 kcal mol^{-1} for C-H rupture in diphenylmethane and 82.3 kcal mol^{-1} for all the other C-H and C-C bond breaking steps. The derived heat of formation of diphenylmethyl radical is 69.0 kcal mol^{-1}. This is in excellent agreement with other studies and indicates that C-H bond rupture in phenylmethanes behaves analogously to C-C rupture. The extra stabilization in diphenylmethyl radical when compared with α-phenylethyl radical is $\sim$ 4 kcal mol^{-1}.

63 **(DOE/ER/10840—3) Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.** (Kentucky Univ., Lexington (USA)). 1983. Contract AS05-81ER10840. 143p. NTIS, PC A07/MF A01. Order Number DE84001522.

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Research performed during the third year are presented for: (1) triaxial compression testing apparatus; (2) elastic properties

versus ultimate analysis of coal; (3) general macrostructural considerations; and (4) microstructural considerations. The following seven appendices describing the researches in detail are attached: (1) modification of loading cell; (2) static determination of the anisotropic elastic moduli of coal; (3) relation between the structure and some physical properties of coal; (4) description of experimentation regarding the analysis of the compressive strength of coal with regard to its chemical properties; (5) sample analyses and trial correlations of mechanical properties with chemical analyses; (6) some considerations on studies of the mechanical behavior of rocks; (7) calculating the elastic contents of graphite. All papers have been abstracted and indexed for the Energy Data Base.

64 (DOE/ER/10840—3, pp 14p, Paper I) **Modification of loading cell.** 1983. NTIS, PC A07/MF A01.

In Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.

The purpose of this test was to determine the elastic properties of coal using an apparatus and technique recently developed by the University of Kentucky. It has been determined in earlier tests conducted by other individuals that coal's elastic properties behave differently, depending on the size, shape and composition of the samples being tested. Since coal is anisotropic and nonhomogeneous in nature, variation in the elastic properties of a specific samples should be expected. To overcome the effects of local discontinuities, larger samples would be preferred giving rise to the development of a new apparatus (Cannon). The Cannon was modified to provide a multiaxial testing apparatus. Refinements were made to the multiaxial apparatus to eliminate possible sources of error. The apparatus was recalibrated with new features added which will be discussed later by using an Aluminum cube. These new features included the installation of three pressure transducers, a Borehole-Pressure Signal Scaler (developed by the University of Kentucky) and 2-XYY Recorders. Other modifications were made to simplify the system and testing procedures. 5 figures.

65 (DOE/ER/10840—3, pp 35p, Paper II) **Static determination of the anisotropic elastic moduli of coal.** Szwilski, A.B. (Univ. of Kentucky, Lexington). 1983. NTIS, PC A07/MF A01. Contract AS05-81ER10840.

In Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.

A method that determines the two, mutually orthogonal, effective elastic moduli in the plane perpendicular to the borehole has been developed. The theory relates the radial displacements in a cylindrical borehole in an elastically orthotropic material. A triaxial compression cell capable of loading 30.5 cm coal cubes by means of six steel flatjacks was used. Measurement of surface displacements of a centrally drilled borehole were taken using a USBM deformation gauge. The influence of the principal structural features of coal on the elastic behaviour and other deformational characteristics are discussed. 17 references, 10 figures, 3 tables.

66 (DOE/ER/10840—3, pp 17 p, Paper III) **Relation between the structure and some physical properties of coal.** 1983. NTIS, PC A07/MF A01.

In Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.

A review on earlier investigations on the correlations between the elastic properties of coal and its rank is presented.

67 (DOE/ER/10840—3, pp 8p, Paper IV) **Description of experimentation regarding the analysis of the compressive strength of coal with regard to its chemical properties.** 1983. NTIS, PC A07/MF A01.

In Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.

The University of Kentucky, Department of Mining Engineering (UKDME) laboratory collected blocks of coal from several mines in Eastern Kentucky in order to help determine whether the chemical composition (and physical constraints) effect the compressive strength of coal. Samples from seven different mines were taken and tested in the UKDME lab. The residue of each sample was chemically analyzed by the Institute of Mines and Minerals Research (IMMR). The results of both series of analyses were put together with the help of certain simple data processing programs to draw a conclusion. Each coal core and cube was analyzed in most of the following categories: Length, Diameter, percent of Carbon, percent of Ash, percent of Nitrogen, percent of Hydrogen, Poissons Ratio, Youngs Modulus of Elasticity, Failure (under load), and BTU's. Each category was graphed with the percent Carbon and with Failure. It was observed that Compressive strength and percent of Ash were directly proportional to each other and inversly proportional to the percent of Carbon. 5 figures, 2 tables.

68 (DOE/ER/10840—3, pp 25p, Paper VII) **Calculating the elastic constants of graphite.** Gillis, P.P. (Univ. of Kentucky, Lexington). 1983. NTIS, PC A07/MF A01.

In Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.

The elastic constants of crystalline graphite are calculated from a fairly simple model. The bending and stretching force constants of the carbon-carbon bonds, along with the crystal geometry, determine the elastic compliances. The key ingredient to the success of the calculation is the selection of suitable bending and stretching force constants for the in-plane and out-of-plane bonds. 4 figures.

69 **(DOE/MC/19210—1492) Computed tomography of coals. Quarterly technical progress report No. 3, March 6, 1983-June 30, 1983.** Maylotte, D.H.; Kosky, P.G.; Spiro, C.L.; Lamby, E.J. (General Electric Co., Schenectady, NY (USA). Research and Development Center). 1983. Contract AC21-82MC19210. 77p. NTIS, PC A05/MF A01. Order Number DE84002394.

X-ray computed tomography (CT) is a non-destructive non-invasive technique for investigating the structures within coal. CT digital images have been taken for a number of coals with a range of rank from anthracite to lignite. Techniques have been developed for the location of the x-ray fan beam during the acquisition of the CT data and for subsequent physical sectioning of the coal along that plane. Preliminary comparisons have been made between the CT images and the coal surfaces, and an outline is given of the methods to be used in obtaining digital reflectance maps for further, more detailed comparisons. Xenon gas diffusion experiments with Illinois No. 6 coal are also reported. The CT images of the xenon penetration are obtained by difference. The images show the combined effect of adsorption and gas penetration within the coal. A preliminary finding of higher xenon penetration into more mineral-rich vitrain bands is reported. The theoretical bases for interpretation of the gas permeation experiments are developed. 18 references, 31 figures, 5 tables.

70 **(DOE/PC/30250—T1) Chemical structure of coals and related materials. Final report, September 1, 1980-August 31, 1983.** Deno, N.C. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 20 Oct 1983. Contract FG22-80PC30250. 14p. NTIS, PC A02/MF A01. Order Number DE84002522.

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The classical oxidizing agents such as CrVI, MnVII, HNO_3, and O_2 oxidatively degrade coals by initially oxidizing the benzylic positions. In contrast trifluoroperoxyacetic acid (TFPA) initially oxidizes the aromatic rings. The objective of this project was to discover as much information as possible about the chemical structures in coals using TFPA oxidative degradations. The most important conclusion of this project is that the major fraction of hydrogen in 60 to 88%C coals is aliphatic, and this aliphatic hydrogen is largely in hydroaromatic rings. The TFPA oxidative degradations allow the nature of these hydroaromatic rings to be investigated. It is the nature of these oxidations to preserve $(CH_2)_2$ and larger bridges always as the predominant product from such systems and usually in yields of over 50%. In contrast simple CH_2 are almost completely destroyed to form carbon dioxide and water. 18 references, 2 tables.

71 **(DOE/PC/40791—T2) Research on advanced optical techniques for diagnostics, control, and safety in fossil energy processes. Final technical report.** (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Mar 1983. Contract FG22-81PC40791. 29p. NTIS, PC A03/MF A01. Order Number DE84001245.

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Work on this program has been progressing in five areas, three experimental and two theoretical. The theoretical activities are the development of spectral modeling computer programs in support of the experimental work. These five areas are: (A) collection of high resolution absorption spectra of chemical species of importance to advanced fossil energy processes, (B) development of hollow cathode emission lamps as sources of inexpensive radiation to be used in making species concentration measurements, (c) developments of the CARS technique for making temperature and species concentration measurements in the particle laden, luminous environments characteristic of fossil fuel combustion, (D) development of computer code to synthetically produce CARS spectra as a function of temperature, species concentration and gas composition, and (E) development of computer code to generate both absorption and emission spectra of the chemical species under study in parts A and B.

72 **(DOE/PC/40793—T8) Predictors of plasticity in bituminous coals. Technical progress report No. 8.** Lloyd, W.G.; Reasoner, J.W.; Hower, J.C.; Yates, L.P.; Clark, C.P.; Davis, E.; Fitzpatrick, A.; Reagles, C.L.; Whitt, J.M. (Western Kentucky Univ., Bowling Green (USA)). 1 Sep 1983. Contract FG22-81PC40793. 61p. NTIS, PC A04/MF A01. Order Number DE83018177.

The greater part of the present study on predictors of coal fluidity has now been completed, with most of the developed database presented in the preceding Technical Progress Report. The one critical area in which we have fallen behind schedule is that of isothermal fluidity measurements at superatmospheric pressures. During the past quarter we have made several modifications to the experimental high-pressure Gieseler plastometer, and have been able to complete over 60 superatmospheric runs. This work will be completed and analyzed within the period of the 90-day no-cost extension which has been granted. The extra time has permitted completion of additional experiments in solvent extraction. During this period we have also completed characterization of THF extracts by HPLC, and characterization of coals, coal extraction residues and selected extracts by FTIR. 13 references, 25 tables.

73 **(DOE/PC/40810—7) Synthesis of oligomeric models of coal derived materials for use with GPC calibration. Quarterly report, July-September 1983.** Baltisberger, R.J.; Jones, M.B. (North Dakota Univ., Grand Forks (USA). Dept. of Chemistry). Oct 1983. Contract FG22-81PC40810. 18p. NTIS, PC A02/MF A01. Order Number DE84002050.

A series of model oligomers were used to calibrate a series of four high pressure gel permeation columns. Three types of model compounds used in the experiment were commercially prepared polystyrene polymers, a series of oligo(aryl ethers) prepared at our laboratory and a series of oligo(aryl methylenes) prepared at our laboratory. It was found that a nearly linear relationship exists between the logarithm of the molecular weight and the retention volumes using tetrahydrofuran solvent as long as the aryl groups in the oligomer were of the benzenoid type. Aryl oligomers containing more condensed ring systems such as naphthyl or phenanthryl moieties give too great a retention volume for their actual molecular weight. Tests with a few low molecular weight hydroxyl containing oligomers give too small a retention volume, indicating that hydrogen bonding with the solvent is occurring. Samples of relatively narrow molecular weight ranges of lignite-derived preasphaltenes and asphaltenes were also analyzed using the same system. In these experiments the samples were acetylated and their number average molecular weight values measured by vapor pressure osmometric means. In the range 2000 to 3000 g/mole, these samples fit the same calibration plot as the polystyrene and aryl-ether oligomers. Those asphaltenes with a high degree of aromatic condensation, particularly at low molecular weight, behaved in a fashion analogous to our more condensed models, i.e., the retention volumes were too large. We plan to investigate this phenomenon further by preparing some vinylnaphthalene, and vinylpyrene oligomers as calibration standards in our future work. 15 references, 3 figures, 5 tables.

74 **(DOE/PC/50788—T4) Dissolving coal at moderate temperatures and pressures. Quarterly report No. 4, May 20-August 19, 1983.** Hirschon, A.S.; Sundback, K.A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 29 Sep 1983. Contract FG22-82PC50788. 19p. NTIS, PC A02/MF A01. Order Number DE83017763.

The objective is to develop an economical method for solubilizing the maximum amount of coal with the minimum loss of carbon. Progress reports are presented for the following tasks: (1) demineralization of PSOC 26 coal; (2) solvent extraction of demineralized PSOC 26 coal; (3) oxidations with nitric acid; (4) oxidations with aqueous NaOCl; (5) oxidations with oxygen; (6) reactions of black acids with CO and base; (7) pyrolysis of black acids. 8 tables.

75 **(DOE/PC/50797—T3) Novel analytical approaches to coal beneficiation. Progress report.** Griffiths, P.R. (California Univ., Riverside (USA). Dept. of Chemistry). 8 Aug 1983. Contract FG22-82PC50797. 11p. NTIS, PC A02/MF A01. Order Number DE84000952.

In this project period most of our effort has been focused on studying the effect of experimental variables on the diffuse reflectance spectra of coals. Although much of our emphasis has been placed on studying coals from the Penn State/DOE Coal Bank without any treatment other than grinding, the effects of oxidation and dilution in a nonabsorbing matrix such as KCl have also been investigated. In addition we have begun work on the development of techniques for monitoring coal pyrolysis by FT-IR spectrometry as well as other analytical techniques. 4 figures.

76 **(DOE/PC/50801—4) Laser induced coal fluorescence. Fourth quarterly technical progress report, July 1-September 30, 1983.** Borst, W.L. (Southern Illinois Univ., Carbondale (USA). Dept. of Physics). 1983. Contract FG22-82PC50801. 7p. NTIS, PC A02/MF A01. Order Number DE84002283.

The work during this reporting period concentrated on software development and preliminary measurements of laser induced fluorescence in coal. The equipment acquired for the project so far has been interfaced and is operating. The fluorescence decay times and spectra from a series of resinite coal macerals were measured and analyzed. The accuracy and reproducibility in the determination of fluorescence decay times was established by using fluorescence standards (e.g. organic dyes and plastic scintillators) and coal macerals in a repetitive way. The tasks performed are in accordance with the original project schedule. 2 figures, 1 table.

77 **(DOE/PC/50807—T4) Reaction calorimetry for coal chemistry and catalysis. Quarterly reporting period, August 1-October 31, 1983.** Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). 1983. Contract FG22-82PC50807. 11p. NTIS, PC A02/MF A01. Order Number DE84001825.

Thermochemical investigations of five solid acids - silica gel, sulfonic acid ion exchange resin (Dowex) and three coal samples of different ranks (Wyoming Rawhide Subbituminous, Texas Big Brown Lignite, Illinois No. 6 Bituminous) are reported. Heats of immersion of these solid acids in 10 to 15 basic liquids have been measured at 80°C using the C-80 Setaram high temperature calorimeter and are reported herein.

78 **(DOE/PC/50809—T3) Determination of the surface reactivity of coal powders. Fourth quarterly report, June 1-August 31, 1983.** Fowkes, F.M. (Lehigh Univ., Bethlehem, PA (USA)). 26 Oct 1983. Contract FG22-82PC50809. 8p. NTIS, PC A02/MF A01. Order Number DE84001662.

A main goal of this project is to determine the surface concentrations and strengths of acidic and basic sites on the surface of powdered coal using flow microcalorimetry and then to use this basic data to learn to interpret the distribution of zeta-potentials of these same powders in organic acidic or basic media. During this quarter we have been learning how best to measure the heats of adsorption of model acids and bases on a variety of coal powders.

79 **(LA—9845-MS) Estimation of radionuclide releases from specific large coal-fired industrial and utility boilers.** Greiner, N.R.; Williams, M.D.; Wagner, P. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 227p. NTIS, PC A11/MF A01. Order Number DE84002309.

To present clearly and concisely the conclusions reached in this work, it is necessary to consider briefly the scope of the project and some assumptions used in reaching the stated conclusions. Available data on radionuclides in coals and fly ash emissions from utility and industrial boilers were reviewed. From these data and estimates of radionuclide content of fly ash, radionuclide releases from utility plants and boilers were estimated. To make these estimates, we assume that all the released radioactivity is either in, or condensed on the surface of, particulate matter that escapes from the plant (that is a good assumption since the gaseous radionuclides are very greatly diluted upon discharge into the atmosphere). Next, it is necessary to consider the particle size distribution in any given plant in the context of that plant's emission control devices in order to calculate the particulate, and thus the radionuclide, release. This was done using plant descriptions, information from the literature, and existing data bases. We concluded that annual releases of non-gaseous radionuclides from the 10 largest utility plants using coals with the highest uranium concentrations range from 0.114 to 0.926 Ci per year. If these particulate releases are analyzed in terms of an atmospheric dispersion model, further estimates indicate that the natural radiation background could be elevated by as much as 20% under the worst combinations of discharge, atmoshperic conditions, wind patterns, etc. In general, the elevation of the natural background radiation from radioactive releases from coal-fired plants is in the 1 to 10% range. The quantitative data on which these conclusions are based are in the body of the report. 12 references, 4 figures, 7 tables.

80 **Thermophysical properties of coal liquids; 2. correlating coal liquid densities.** Holder, G.D.; Gray, J.A. (Gulf Research and Development Company, Pittsburgh, Pennsylvania 15230). *Industrial and Engineering Chemistry Process Design and Development;* **22**: No. 3, 424-428(Jul 1983).

An evaluation of several correlations for predicting saturated densities of coal-derived liquids from boiling point and specific gravity indicates that the best correlating equation is a one-constant modification of the Rackett equation with 0.4% average error and EDS liquid densities with a 1.1% average error. The correlations appear to be valid to at least 95% of the critical temperature. A new correlation for predicting specific gravity from the boiling point allows the liquid densities to be predicted from the boiling point alone. given by p /SUB r/ = 0.28412 (1-T /SUB R/ >2/7.

81 **Thermophysical properties of coal liquids; 1: selected physical, chemical, and thermodynamic properties of narrow boiling range coal liquids.** Gray, J.A.; Brady, C.J.; Cunningham, J.R.; Freeman, J.R.; Wilson, G.M. (Gulf Research and Development Company, Pittsburgh, Pennsylvania 15230). *Industrial and Engineering Chemistry Process Design and Development;* **22**: No. 3, 410-423(Jul 1983).

Liquid products from the SRC-II processing of a high volatile bituminous coal were distilled into narrow boiling range fractions with average boiling points ranging up to 800 K. Liquid density, thermal conductivity, and viscosity were measured at temperatures to 505 K, and specific heat was determined to 600 K. Other property determinations included molecular weight, pour point, elemental analyses, water content and solubility, and hydrocarbon types. Both organic oxygen content and water solubility showed a pronounced maximum for the fraction having an average boiling point of 470 K and significantly influenced density. A secondary distillation on six different fractions spaced over the entire boiling range yielded heart cuts spanning 4-26 K that were used for measurement of surface tension, heat of vaporization, and vapor pressure at temperatures to 755 K. Property data for all the fractions are compared with other published data and existing property correlations.

82 **Analysis of upgraded SRC-II and H-coal liquid products.** Young, L.J.S.; Hardy, D.; Li, N.C. (Department of Chemistry, Duquesne University, Pittsburgh, PA 15282). *Fuel;* **62**: No. 6, 718-723(Jun 1983). Contract AC22-80PC30252.

Upgraded coal-derived liquids obtained from catalytic hydroprocessing of SRC-II and H-coal syncrudes have been studied by I.R., P.M.R., G.C.-M.S., and silica gel chromatography. With increase in residence time, nitrogen, oxygen and aromatics decrease, while naphthenes increase substantially. All the upgraded liquids show low viscosity at 298 K (1.3-1.4 mN s m^{-2}), even though saturate and aromatic fractions varied with processing severity. In the aromatic-I fraction, 1-ring aromatics increase, and 3-ring aromatics decrease, with increase in severity of hydroprocessing. G.C.-M.S. analyses indicate a marked qualitative similarity for saturate and aromatic fractions irrespective of syncrude source. Only the heavier end of the aromatic-I fraction is noticeably different. Tentative identifications based on M.S. and G.C. retention times are made for most of the significant components. 600 MHz P.M.R. spectra of the upgraded SRC-11 and H-coal liquids appear identical, but the N.M.R. difference technique revealed slight differences between the two liquids in concentrations of certain species.

83 **Electrochemistry of Coal Slurries; II: studies on various experimental parameters affecting oxidation of coal slurries.** Dhooge, P.M.; Su-Moon Park. (Department of Chemistry, The University of New Mexico, Albuquerque, New Mexico). *Journal of the Electrochemical Society;* **130**: No. 5, 1029-1036(May 1983). Contract AC21-81MC16377.

The anodic oxidation of coal slurries has been studied under various experimental conditions. Results obtained from various experiments support the mechanism of the catalytic oxidation of coal slurries by iron (III in solution, followed by the oxidation of reduced iron (II) to iron (III) at the electrode. The oxidation of coal slurries by iron (III) in solution is found to be a first-order process with respect to both reactants, i.e., coal and iron (III), from concentration dependency studies, indicating that the overall reaction may consist of a sequence of one-election transfers. It may also be concluded from various experimental results that the electrolysis reaction proceeds through the sequential formation, first of carbon oxides on the coal surface, and then of carbon dioxide as a final product. Of various catalyst oxidants studied, bromine and cerium (IV) appear to have the largest pseudo first-order catalytic rate constants with 1.1 X $10^{-3}$$sec^{-1}$ and 4.1 X $10^{-4}$$sec^{-1}$, respectively. Redox potentials of the catalyst pairs appear to be the most important parameter in determining catalytic reaction rates.

84 **The reaction of coke specimens in an environment where both the temperature and the gas composition are time dependent.** Aderibigbe, D.A.; Szekely, J. (The Mechanical Engineering Department, University of Lagos, Akoka, Yaba, Lagos, Nigeria). *Metallurgical Transactions,* [*Section*] *B: Process Metallurgy;* **13B**: 513-515(Sep 1982).

The purpose of this communication is to comment on the appropriateness of the currently employed testing procedures for evaluating the performance of coke in the iron blast furnace. It points out that while the ultimate test of coke quality is its actual performance in the real operating blast furnaces, it is clearly desirable to devise tests that enable one to predict how a given type of coke would behave without resorting to expensive, large scale trials, performed under industrial conditions. It suggests that the way in which metallurgical coke reacts in the iron blast furnace may depend quite critically on its previous history (in terms of the temperature and gas composition to which the particle was exposed). The "intrinsic reactivity" of a given coke sample may vary quite markedly with furnace operation and that the currently employed simple coke reactivity tests are unlikely to provide information on this type of behavior.

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REFER ALSO TO CITATION(S) 29, 104, 108, 114, 115, 116, 735

85 **(CONF-821048—6) University of Minnesota-Duluth low-Btu gasifier workplace environment.** Van Hoesen, S.D.; Dreibelbis, W.G.; Thompson, F.M.; Hunt, D.B. (Oak Ridge National Lab., TN (USA); Minnesota Univ., Minneapolis (USA); Radian Corp., Salt Lake City, UT (USA)). 1982. Contract W-7405-ENG-26. 54p. NTIS, PC A04/MF A01. Order Number DE84002545.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

A summary of the results of the industrial hygiene (IH) studies performed at the University of Minnesota-Duluth (UMD) gasifier is presented. The initial step in implementing the IH assessment program at UMD was the development of an IH plan. The purpose of this plan was to identify the potential IH stresses that might be experienced at the gasifier and to develop means for analyzing and monitoring these stresses and for determining the effectiveness of control measures. Through a review of the plant design and available information on coal conversion experience, a number of potential IH stresses were identified. These stresses and the currently recommended limits for worker exposure are presented. The plan contained provisions for both area and personal monitoring for these stresses. The IH monitoring plan included provisions for evaluating personal exposures to carbon monoxide, other toxic gases, organic materials (coal tar), dust, heat stress, and noise. A toxicology program was undertaken to provide information on important process materials such as electrostatic precipitator (ESP) tar. Newly developed IH instruments were field tested and used as research tools for evaluating exposure to organic materials. A medical surveillance program was also instituted to evaluate worker health. In addition, operational parameters and IH experiences were evaluated to correlate IH monitoring results with plant operating conditions to allow evaluation of exposure controls. 7 references, 9 figures, 15 tables.

86 **(DOE/MC/14803—T1) Utilization of waste brick disposal facility. Final report, October 1, 1980-September 30, 1981.** Slonaker, J.F.; Carlisle, J.A.; Muter, R.B.; Simonyi, T.A. (West Virginia Univ., Morgantown (USA). Coll. of Mineral and Energy Resources). 1981. Contract AT21-80MC14803. 45p. NTIS, PC A03/MF A01. Order Number DE84001932.

The research program undertaken had four primary objectives, listed as follows: (1) to investigate the physical and chemical behavior of wet high sulfite, scrubber sludge subjected to ultrasonic screening, and to assess the effectiveness of this technique for facilitating sludge disposal; (2) to investigate the utilization of dewatered sulfite scrubber sludge as a component in autoclaved structural products as a direct disposal alternative; (3) to determine the feasibility of the production of kiln-fired, coal-based, insulating structural shapes incorporating coal and coke as combustible additives; and (4) to monitor the physical behavior of flyash blocks in non-reactive (ambient) and marine environments. This was a joint effort undertaken with the State University of New York (SUNY) at Stonybrook, LI, to develop a novel disposal method for coal-associated wastes produced in the New York area. This final report summarizes data and discusses the results. Discussion is presented under the headings: dewatering scrubber sludge, autoclaved structural products, kiln-fixed coal-based insulating structural shapes, and production and testing of flyash blocks. 5 references, 15 figures, 19 tables.

87 **(DOE/MC/16427—T2) Testing of the Dowa aluminum based double alkali FGD process at the DOE Shawnee Test Facility.** Burbank, D.A.; Rabb, D.T. (Bechtel Group, Inc., San Francisco, CA (USA)). Apr 1983. Contract AC22-81MC16427. 31p. NTIS, PC A03/MF A01. Order Number DE83013084.

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The Dowa basic aluminum sulfate desulfurization process is being tested to demonstrate the process for SO_2 removal from the flue gas generated by a coal-fired boiler. This report summarizes the second demonstration program conducted on a 10 MW equivalent modified Turbulent Contact Absorber (TCA) located at the TVA Shawnee Steam Plant, Paducah, Kentucky. It included the operation of an improved sulfite forced oxidation system and demonstrated the aluminum recovery system for approximately seven days. The Dowa process was capable of removing 90 to 95 percent of the SO_2 in flue gas from a coal-fired utility boiler at inlet SO_2 concentrations of approximately 2000 ppM and with a limestone utilization of essentially 100 percent for short periods. The process produces a fully oxidized solids waste (gypsum) but also produces a liquid waste stream containing high total dissolved solids. The main objective of demonstrating the long-term reliability of the process under commercial conditions was not met because of the difficulties in the control of solution basicity and the delay in selecting a suitable scrubber packing for testing. 2 figures, 5 tables.

88 (LBL—15298, pp 4.83-4.88) **Scrubber chemistry research.** Chang, S.G.; Littlejohn, D.; Lynn, S. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Topics covered include: the effects of metal chelates on wet flue gas scrubbing chemistry, the reaction of ferrous nitrosyl complexes with sulfite and bisulfite ions, and identification of species in a wet flue gas desulfurization and denitrification system by laser Raman spectroscopy.

89 **(NMERDI—2-68-3215) Development of flyash as a filter media for hydrocarbons. Final report.** Wilson, D.B. (New Mexico State Univ., Las Cruces (USA). Dept. of Chemical Engineering). Sep 1982. 110p. NTIS, PC A06/MF A01. Order Number DE84900200.

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This report describes the investigation of using flyash as a filter media (adsorbent). Three systems are examined: (1) flyash as a replacement for clay in the conventional acid-clay treatment of rerefined lubricating oil. The potential for subsequent use of the reject acid sludge (contains flyash) for cement kilning is examined; ,2) flyash as an adsorbent for separating water from the ethanol-water azeotrope. Subsequent disposal of the flyash is discussed; and (3) flyash as an adsorbent for radioactive material from aqueous solutions. Results indicate that flyash is an acceptable substitute for diatomaceous earth as a precoat material or filter aid in rotary vacuum filtration. The structure of the flyash provided good retention of solids (clays) at high filtration rates. Flyash did not remove the color from rerefined lubricating oil and was not considered further as a replacement for clay in this application. Flyash adsorbed a small quantity of water from the ethanol-water azeotrope; however, it was not as good an adsorbent material as Davidson 3A molecular sieve. Flyash does have a cost advantage (excluding shipping) and if the spent adsorbent flyash could find use as a soil conditioner (or other local use), it could be used on a once-through basis. Flyash did not adsorb radium to any appreciable extent; however, it was a satisfactory filter aid material for use to increase the permeability of the filter cake when clay was used to adsorb the radium. Flyash did not leach any contaminants into the three systems examined - lube oil, ethanol-water, and radium (aqueous) solution. 26 references, 21 figures, 18 tables.

90 **Demineralization for reuse of coal conversion condensates.** Campbell, J.R.; Dzombak, D.A.; Luthy, R.G. (Department of Civil Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Industrial and Engineering Chemistry Process Design and Development;* 22: No. 3, 496-502(Jul 1983).

Zero discharge-oriented water management strategies for coal conversion facilities indicate that process wastewater is a prime source of cooling tower makeup water, and that a demineralization technology will be employed for process wastewater to achieve the quality criteria necessary for operating cooling towers at high cycles of concentration. This will help to maximize water reuse as well as to help minimize the production of brine. Reverse osmosis (RO) was considered to be the most appropriate of available demineralization processes, a laboratory-scale RO experiments were conducted with a phenolic coal gasification wastewater which had been processed through a series of pretreatment steps including activated carbon adsorption. Tests conducted with a polyamide membrane gave somewhat higher product water quality, while the

cellulose triacetate membrane provided greater flux rates. Membrane fouling was not observed with the polyamide membrane owing to wastewater pretreatment and addition of sodium metaphosphate inhibitor. Long-term studies are required to confirm this observation.

91 **Anaerobic filters for the treatment of coal gasification wastewater.** Suidan, M.T.; Kao, S.W.; Pfeffer, J.T.; Siekerka, G.L. (Department of Civil Engineering, University of Illinois, Urbana, Illinois 61801). *Solar Energy;* XXV: No. 6, 1581-1596(Jun 1983). Contract AC21-80MC14713.

A process train consisting of the following sequence of unit processes, a berl-saddlepacked anaerobic filter, an expanded bed, granular activated carbon anaerobic filter, and an activated sludge nitrification system was evaluated for the treatment of a synthetically prepared coal gasification wastewater. The first-stage anaerobic filter resulted in very little removal of organic matter and no methane production. Excellent reduction in organic matter occurred in the granular activated carbon anaerobic filter. The removal mechanism was initially adsorptive and near the end of the study, removal of organic matter was primarily through conversion to methane gas. It is felt that the success of the activated carbon anaerobic filter was due to the ability of the activated carbon to sequester some components of the wastewater that were toxic to the mixed culture of anaerobic microorganisms. The activated sludge nitrification system resulted in complete ammonia oxidation and was very efficient in final effluent polishing.

92 **Reduced sulfur in ashes and slags from the gasification of coals: availability for chemical and microbial oxidation.** Strayer, R.F.; Davis, E.C. (Oak Ridge National Laboratory, TN). *Applied and Environmental Microbiology;* 45: No. 3, 743-747(Mar 1983). Contract W-7405-ENG-26.

The study was initiated to determine if reduced sulfur contained in coal gasifier ash and slag was available for microbial and chemical oxidation because eventual large-quantity landfill disposal of these solid wastes is expected. Continuous application of distilled water to a column containing a high-sulfur-content (4% [wt/wt]) gasifier slag yielded leachates with high sulfate levels (1,300 mg of sulfate liter^{-1}) and low pH values (4.2). At the end of the experiment, a three-tube most-probable-number analysis indicated that the waste contained 1.3 x 10^7 thiosulfate-oxidizing bacteria per g. Slag samples obtained aseptically from the column produced sulfate under both abiotic and biotic conditions when incubated in a mineral nutrient solution. Both microbial and chemical sulfate syntheses were greatly stimulated by the addition of thiosulfate to the slag-mineral nutrient solution. These results led to a test of microbial versus chemical sulfur oxidation in ashes and slags from five gasification processes. Sulfate production was measured in sterile (autoclaved) and nonsterile suspensions of the solid wastes in a mineral nutrient solution. These ashes and slags varied in sulfur content from 0.3 to 4.0% (wt/wt). Four of these wastes demonstrated both chemical (2.0 to 27 μg of sulfate g^{-1} day^{-1}) and microbial (3.1 to 114 μg of sulfate g^{-1} day^{-1}) sulfur oxidation. Obvious relationships between sulfur oxidation rate and either sulfur content or particle size distribution of the wastes were not immediately evident. We conclude that the sulfur contained in all but one waste is available for oxidation to sulfuric acid and that microorganisms play a partial role in this process.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 1, 79, 99, 100, 101, 102

93 **(EPA—600/7-83-017) Morphological variation in Djalmabatista (Diptera: chironomidae) associated with coal-strip-mine ponds.** Tennessen, K.J.; Gottfried, P.K. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Water Resources). Mar 1983. 65p. (TVA/ONR/WRF—83/6). NTIS, PC A04/MF A01. Order Number DE84900273.

Larvae of Djalmabatista pulcher (Johannsen) possessing abnormally-shaped ligulas were found in abandoned coal strip mine ponds near Brilliant, Alabama. Of the total 1472 larvae examined, 50 possessed an abnormal ligula (3.4%), a frequency greater than previously reported for chironomids. Abnormalities were found in larval instars II, III, and IV. Based on monthly samples from June to October 1978, the combined frequency of abnormalities in three strip mine ponds (3.04%) was not significantly different from the frequency at the unmined reference site, Marion County Lake (1.85%) ($P = 0.36$). The frequencies of abnormalities were not significantly correlated with any measured water quality of biological parameter related to strip mine activity.

0110 Reserves And Exploration

94 **(DOE/EIA—0118(82)) Coal production - 1982.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Sep 1983. 121p. NTIS, PC A06/MF A01 - GPO. Order Number DE84001836.

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All data presented in this report, except the demonstrated reserve base data, were obtained from companies owning mining operations that produced, processed, or prepared 10,000 or more short tons of coal in 1982. These data cover 4867 out of the 6427 US coal mining operations active in 1982. These mining operations accounted for 99.3 percent of total US coal production and represented 75.7 percent of the US coal mining operations in 1982. This issue continues the series included as a chapter in the Minerals Yearbook published by the Bureau of Mines on the demonstrated reserve base of coal in the United States on January 1, 1982.

95 **(MLM—3026) Radionuclides in Western coal. Final report.** Abbott, D.T.; Styron, C.E.; Casella, V.R. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 23 Sep 1983. Contract AC04-76DP00053. 28p. NTIS, PC A03/MF A01. Order Number DE84001892.

The increase in domestic energy production coupled with the switch from oil and natural gas to coal as a boiler-fuel source have prompted various federal agencies to assess the potential environmental and health risks associated with coal-fired power plants. Because it has been suggested that Western coals contain more uranium than Eastern coals, particular concern has been expressed about radioactive emissions from the increasing number of power plants that burn low-sulfur Western coal. As a result, the radionuclides in coal program was established to analyze low-sulfur coal reserves in Western coal fields for radioactivity. Samples from seams of obvious commercial value were taken from 19 operating mines that represented 65% of Western coal production. Although the present study did not delve deeply into underlying causative factors, the following general conclusions were reached. Commercially exploited Western coals do not show any alarming pattern of radionuclide content and probably have lower radioactivity levels than Eastern coals. The materials that were present appeared to be in secular equilibrium in coal, and a detailed dose assessment failed to show a significant hazard associated with the combustion of Western coal. Flue gas desulfurization technology apparently has no significant impact on radionuclide availability, nor does it pose any significant radiologic health risks. This study has also shown that Western coals are not more radioactive than most soils and that most solid combustion products have emanation powers <1%, which greatly reduce dose estimates from this pathway. In summary, the current use of mined, Western coals in fossil-fueled power plants does not present any significant radiological hazard.

96 **(USGS-OFR—79-915) Selected coal-related ground-water data, Wasatch Plateau-Book Cliffs Area, Utah. Utah hydrologic-data report No. 32.** Sumsion, C.T. (Geological Survey, Salt Lake City, UT (USA)). 1979. 45p. NTIS, PC A03/MF A01. Order Number DE84900190.

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The Wasatch Plateau-Book Cliffs area as used in this report consists of about 8000 square miles in east-central Utah. The major geographic features included in the area are the Wasatch Plateau, Book Cliffs, San Rafael Swell, Price River basin, and a small part of the Green River basin (pl. 1). The area is defined by approximate drainage-divide boundaries in the Wasatch Plateau and Book Cliffs, by an arbitrary boundary on the south, and by the Utah-Colorado State line on the east. The Wasatch Plateau-Book Cliffs area includes all the operating coal mines in Utah in 1978. Annual

coal production in the area is expected to increase from the current (1978) rate of about 8 million tons to as much as 30 million tons within the next 10 years (J.W. Moffitt, US Geological Survey, oral commun., 1978). Ground water is an important source of water supply in the area. As mining increases and mining-related municipalities grow, many sources of ground-water supply may be subjected to increased demands and possibly degradation of chemical quality. Waddell, Vickers, Upton, and Contratto (1978) reported some ground-water data after a reconnaissance of part of the area. The purpose of this report, which was prepared in cooperation with the US Bureau of Land Management, is to present a more detailed compilation of ground-water-related data that were collected and compiled during October 1976 to March 1978. The report is designed to make the data available in an orderly and usable form for local and regional water managers and other users of water data.

0120 Mining

REFER ALSO TO CITATION(S) 127, 989

97 **(ACIRL-PR—82-9) Methods and equipment used in outburst and gas drainage investigations.** Gray, I.; Truong, D. (Australian Coal Industry Research Labs. Ltd., North Ryde). Oct 1982. 93p. Australian Coal Industry Research Labs. Ltd., North Ryde.

Equipment, techniques and analysis methods developed for outburst and gas drainage research are presented. While the emphasis is on seam gas measurement, some stress measurement techniques are outlined. Analysis of gas drainage is in terms of a modified oil and gas reservoir simulator. Both field and laboratory equipment are described. (16 refs.)

98 **(DOE/ET/10324—T18) Engineering support services for the DOE/GRI coal gasification research program. Evaluation of one method of peat harvesting and dewatering.** Bostwick, L.E.; Fruchthaum, J.; Hubbard, D.A. (Kellogg (M.W.) Co., Houston, TX (USA)). Mar 1981. Contract AC01-78ET10324. 58p. (FE—2778-49). NTIS, PC A04/MF A01. Order Number DE83010940.

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This study assumes that the harvesting and dewatering facilities are self-sufficient in generation of the steam and electric power requirements of the operations, fueled by peat product at 50 percent moisture. Dredges and their associated pumps use diesel fuel. Consequently, about 52 percent of the peat removed from the bog is either used for fuel or lost in dewatering. The study is confined to wet harvesting of peat by dredging and transport of the peat as a low-solids slurry over significant distances, which in turn leads to major capital costs for transport equipment and, at least for slurry handling, high operating costs for transportation fuel. Only commercially available equipment was considered in the design of the harvesting and dewatering operations; as a consequence, the equipment is poorly matched for the scale of this operation. Economics developed for the peat gasification plant producing 250 billion Btu per day of SNG indicate that for an average gas cost of $5.00 per million Btu the cost of the peat feed at 50 percent moisture must not exceed $1.57 per million Btu. If the total plant investment for the gasification plant ranges +-30 percent, the peat feed cost must be in the range of $1.18 to 1.91 per million Btu. This contrasts most unfavorably with the estimated peat costs of $3.76 to $4.58 per million Btu developed in the present study.

99 **(PB—83-237073) Practices for protecting and enhancing fish and wildlife on coal surface-mined land in central and southern appalachia.** Ambrose, R.E.; Hinkle, C.R.; Wenzel, C.R. (Science Applications, Inc., Oak Ridge, TN (USA)). Mar 1983. 222p. NTIS, PC A10/MF A01.

This handbook contains information on the best current practices to minimize disturbances and adverse impacts of surface mining on fish and wildlife resources. Current state and federal legislation was reviewed to determine those practices which were most compatible with the best technology currently available, fish and wildlife plans, and reclamation plans for the Central and Southern Appalachia region of the U.S. The information presented includes risks, limitations, approximate costs, and maintenance and management requirements of each practice.

100 **(PB—83-237081) Practices for protecting and enhancing fish and wildlife on coal surface-mined land in the Powder River-Fort Union region.** Proctor, B.R.; Thompson, R.W.; Bunin, J.E.; Fucik, K.W.; Tamm, G.R. (Science Applications, Inc., Oak Ridge, TN (USA)). Mar 1983. 261p. NTIS, PC A12/MF A01.

This handbook contains information on the best current practices to minimize disturbances and adverse impacts of surface mining on fish and wildlife resources. Current state and federal legislation was reviewed to determine those practices which were most compatible with the best technology currently available, fish and wildlife plans, and reclamation plans for the Powder River-Fort Union region of the U.S. The information presented includes risks, limitations, approximate costs, and maintenance and management requirements of each practice.

101 **(SAND—83-0945C) Stripmine streambed restoration using meander parameters.** Rechard, R.P.; Schaefer, R.G. (Sandia National Labs., Albuquerque, NM (USA); Western Water Consultants, Laramie, WY (USA)). 1983. Contract AC04-76DP00789. 13p. (CONF-8310199—1). NTIS, PC A02/MF A01. Order Number DE84001791.

From Rivers '83 symposium; New Orleans, LA, USA (24 Oct 1983).

The steam pattern parameters, wavelength, radius of curvature, width-depth ratio, and sinuosity, were examined on eleven ephemeral, intermittent, and perennial streams in the eastern Powder River Basin in northeastern Wyoming. Fifteen empirical equations were developed for determining proper meander parameters for stream restoration after surface mining. The design method was applied to one mining site; reasonable parameter values resulted.

102 **(USGS—4900012) Effects of underground mining and mine collapse on the hydrology of selected basins in West Virginia.** Hobba, W.A. Jr. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1981. 91p. NTIS, PC A05/MF A01. Order Number DE84900012.

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The effects of underground mining and mine collapse on areal hydrology were determined at one site where the mined bed of coal lies above major streams, and at two sites where the bed of coal lies below major streams. Subsidence cracks observed at land surface generally parallel predominant joint sets in the rocks. The mining and subsidence cracks increase hydraulic conductivity and interconnection of water-bearing rock units, which in turn cause increased infiltration of precipitation and surface water, decreased evapotranspiration, and higher base flows in some small streams. Water levels in observation wells in mined areas fluctuate as much as 100 feet annually. Both gaining and losing streams are found in mined areas. Mine pumpage and drainage can cause diversion of water underground from one basin to another. Areal and single-well aquifer tests indicated that near-surface rocks have higher transmissivity in a mine-subsided basin than in unmined basins. Increased infiltration and circulation through shallow subsurface rocks increases dissolved mineral loads in streams, as do treated and untreated contributions from mine pumpage and drainage. Abandoned and flooded underground mines make good reservoirs because of their increased transmissitivity and storage. Subsidence cracks were not detectable by thermal imagery, but springs and seeps were detectable.

103 **Corner-cutting mining assembly.** Bradley, J.A. (to US Dept. of Energy). US Patent 4,400,036. 23 Aug 1983. Filed date 1 Jul 1981. vp.

PAT-APPL-279391.

A mining assembly includes a primary rotary cutter mounted on one end of a support shaft and four secondary rotary cutters carried on the same support shaft and positioned behind the primary cutter for cutting corners in the hole cut by the latter.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 98, 1451

104 **(DOE/CPC—83/1) Coal preparation and pollution control: a current awareness bulletin.** Grissom, M.C. (ed.). (USDOE Technical Information Center, Oak Ridge, TN). 30 Oct 1983. 10p. (PB—83900800). NTIS, PC A02/MF A01. Order Number DE84000182.

The subject content of Coal Preparation and Pollution Control encompasses: coal desulfurization and purification, coal waste management, coal preparation, fluidized-bed combustion, power plant air pollution abatement and control, pollution control equipment, and general. The summaries in this bulletin and older citations to information on coal, including coal preparation, cleaning, combustion, and waste management; air pollution control and abatement in fossil-fuel power plants; and pollution-control equipment are available for on-line searching and retrieval in the Energy Data Base using the DOE/RECON system or commercial on-line retrieval systems. Retrospective searches can be made on any aspect of this subject, or customized profiles can be developed to provide current information for each user's needs.

105 **(DOE/FE/05147—1488) Developmental research study of coal-fines agglomeration for fixed-bed gasification. Final report.** Elmquist, S.A.; Girimont, J.A.; Korosi, F.A.; Kuby, O.A.; Nelson, S.G.; Paulin, M.O.; Peterson, C.A.; Baker, R.L.; Saller, E. (McKee (Davy) Engineers and Constructors, Cleveland, OH (USA)). 31 May 1983. Contract AC21-81FE05147. 451p. NTIS, PC A20/MF A01. Order Number DE84001822.

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This report presents the results of an intensive program to develop and evaluate agglomerates made from coal fines for use in a fixed-bed gasifier. There were several tasks completed earlier and their results published prior to this final report. These included: Task 1-A, a literature survey of coal agglomeration, binders and techniques used in coal agglomeration, coal and binder treatments and the results of work done by others; Task 1-B, an examination of performance of lump coals in coal gasification, testing and evaluation of the properties of these coals, and evaluation of mine site coal upgrading methods; and Task 1-C/D, a laboratory investigation of coal agglomerates, including wafers, briquettes and pellets, in which the agglomerated coal fines were formed and tested, and the performance of various coal/binder combinations was recorded and evaluated, and factors affecting commercial scale coal agglomeration and gasification were evaluated. These three prior tasks are presented in this report in condensed form.

106 **(DOE/PC/40285—8) Program of basic research on the utilization of coal-water mixture fuels. Quarterly report for the period ending July 31, 1983.** Casassa, E.Z.; Marnicio, R.J.; Parfitt, G.D.; Rao, S.A.; Rubin, E.S.; Sommer, H.T.; Toor, E.W. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Energy and Environmental Studies). 1983. Contract FG22-81PC40285. 133p. NTIS, PC A07/MF A01. Order Number DE84001794.

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In the area of stability studies, a new sample of Pittsburgh Seam No. 8 coal was characterized by several methods. Electrophoresis, rheology and sedimentation experiments have been continued using slurries of four coals in solutions of four different surface-active agents and surface tension measurements on slurry supernatants have been started (Task 8). In the area of atomization studies,progress was made in three parts of the program: (1) the spray test facility was disssembled during this research period to investigate erosion and clogging of pressure transducer tabs. The design of the facility was improved and structural changes were introduced to accommodate future experimental requirements. Spray experiments with water were conducted to identify the influence of viscosity on the atomization characteristics; (2) collision and agglomeration algorithms were included in the spray simulation program and the importance of collision and agglomeration on the spray pattern was analyzed; (3) the theory developed to describe the flow in a rotating cup atomizer was supplemented with a Non-Newtonian Viscosity model. This model takes into account the influence of the rate of strain on the slurry viscosity. The temperature dependency of the slurry properties was also added. Two rotating cup atomizer experiments are currently under development. Design of the experiment to verify the theory was conducted and construction is in progress. An industrial scale commercially rotating cup burner was negotiated with Fluidcarbon, Sweden, and will be installed for spray characterization soon. Experiments to identify the influence of the multigravity force field on the settling velocity have been conducted and a linear correlation was observed in experiments.

107 **(DOE/PC/62690—T1) Evaluation of the effect of coal cleaning on fugitive elements. Phase IV. Identification of mineral forms in coal. First quarterly progress report, May 12, 1983-August 31, 1983.** Ford, C.T. (Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.). 15 Sep 1983. Contract AC22-83PC62690. 10p. NTIS, PC A02/MF A01. Order Number DE84001839.

The purpose of this fourth phase of the programmatic research is to delineate the effect of coal cleaning on mineral forms in the ash from coal preparation plants. Samples from the previous three phases of this study were selected for use in determining mineral forms for this project, and low-temperature ashing of those samples was initiated. An x-ray diffractometer was selected and purchased to be used along with infrared spectrophotometry for determining the forms of minerals in the coal. 1 figure, 2 tables.

108 **(IS—4839) Characterization and performance evaluation of fly ash-derived heavy-medium material. Final report.** Birlingmair, D.; Murtha, M.; Killmeyer, R. (Ames Lab., IA (USA)). 31 Mar 1983. Contract W-7405-ENG-82. 54p. NTIS, PC A04/MF A01. Order Number DE84001858.

This project was divided into two tasks: Task A, in which fly ash-derived heavy-medium materials were characterized and Task B, in which the performance of such material in a heavy-medium cyclone was evaluated. In Task A, suspensions of several heavy-media materials, both fly ash-derived (FAM) and commercial, were evaluated in a test loop to determine physical and chemical characteristics, media stabilities and rheologies, particle durability, abrasion of equipment materials, and flow circuit power requirements. The FAM was found to have a lower density and a higher magnetics content than the commercial magnetite. Neither material experienced significant attrition during 300-hour test runs. The FAM suspensions resulted in a lower or equal abrasion rate on the various equipment materials tested. For those materials tested, the order of resistance to abrasion was (from high to low): stainless steel, aluminum, brass, and black iron. In Task B, the performance characteristics of a heavy-medium cyclone using a commercial magnetite and two FAMs were evaluated to compare separation efficiencies. In general, at a specific gravity of separation of about 1.325, the commercial magnetite yielded the sharpest separation (Ep of 0.021), with the coarse fly ash-derived material (FA1) providing the next best (Ep 0.036), and the fine FAM (FA2) resulting in the poorest (Ep 0.050). 15 references, 29 figures, 15 tables.

109 **(N—8321353) Analysis of the market for a new frozen coal release device.** Taglio, S. (SRI International, Menlo Park, CA (USA)). Dec 1981. 31p. (NASA-CR—170101). NTIS, PC A03/MF A01.

Conditions that contribute to coal freezing and the costs of frozen coal handling are discussed. The various methods currently used to handle frozen coal are examined and assessed relative to costs, effectiveness, and advantages and disadvantages. A NASA designed gas detonation lance for breaking the ice bonds between frozen coal nuggets is described and illustrated. Market demand for the controlled gas detonation lance is estimated to be at least 10 units.

110 **(PB—83-238758) Removal of pyrite from coal by heap leaching. Open file report (final) 30 Sep 79-31 Dec 82.** Cathles, L.M.; Breen, K.J. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Jun 1983. 287p. NTIS, PC A13/MF A01.

The feasibility of leaching pyrite from coal heaps is analyzed by adapting a model of the heap-leaching process developed in the copper industry. Parameters in the model are first determined through literature review and direct measurement. The model is then used to predict how coal fragments will leach in reaction kettles containing ferric sulfate solution, in columns through which air is circulated, and in actual heaps. Model parameters are verified and refined by kettle and column experiments. Removal of pyrite from coal utilizing such a process is economically attractive. A heap-leaching operation capable of depyritizing 1 million tons of coal per year has a positive net present value at discount rates up to 16% (base case) to 33% (best case).

111 **(VTT-TUTK—125) Development of delivery, handling and combustion of peat pellets.** (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1982. 175p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo, Finland.

The aim of the study was to investigate the state and needs of development work concerning delivery, handling and combustion techniques and to carry out development work both theoretically and in practice. The study was limited to deal with houses where heat is produced mainly with light fuel oil. The delivery of peat pellets can be done either straight from the factory, or so-called two-phase transportation can be used, where pellets are delivered through intermediate stores. The costs of delivery vary on a large scale depending on the mode of transportation and vehicles by which the pellets are transported. Graphic curves are developed for estimating the delivery costs in various situations. Feeding of peat pellets to the burner can be done by equipment actually designed for wood chips. However, some changes must be done, for example to feeding screws. Equipment designed for small houses and wood chips is more suitable for larger buildings when used for feeding of peat pellets. For small houses they are too heavy and complicated and for that reason too expensive. There is no equipment actually designed for peat pellets on the market. The burning of peat pellets was most complicated in the whole consumption chain. Burning equipment designed for more wet fuels are not suitable for burning dry and energy-intensive peat pellets. In the field of burning equipment considerable development work is needed. Peat pellets are more economic when used in larger boilers where the boiler effect is higher than 100 kW. The final price of energy is then lower than with light fuel oil. In small houses the investment in burning and handling equipment raises the price of heat produced by peat pellets to higher than that produced with other energy. The situation will be different when the new technology for peat pellets is developed.

0140 Combustion

REFER ALSO TO CITATION(S) 54, 56, 71, 106, 111, 190

112 **(CONF-8310180—1) Low-temperature combustion kinetics of western Kentucky No. 9 coal.** Daw, C.S.; Krishnan, R.P. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 42p. NTIS, PC A03/MF A01. Order Number DE84002067.

From Fall symposium of the American Flame Research Committee; Akron, OH, USA (4 Oct 1983).

The combustion kinetics of Western Kentucky No. 9 coal was measured in a tubular-flow reactor. The primary objective was to develop a kinetic expression suitable for calculating the combustion rate of devolatilized char in an atmospheric fluidized bed combustor. Coal particles ranging from about 0.64 to 0.033 cm (0.25 to 0.013 in.) diameter were devolatilized and burned in air/nitrogen mixtures at reactor temperatures between 866 and 1090K (1100 and 1500°F) and at oxygen partial pressures between 0 and 0.21 atmospheres. Experiments with subliming naphthalene provided data for correlating the mass transfer between particles suspended in the reactor and the bulk gas stream. This correlation was then combined with the combustion data to separate the two primary rate components: external oxygen diffusion and intra-particle diffusion/reaction. The experimental results demonstrate that combustion of particles of about 0.64 cm (0.25 in.) diameter is almost completely dominated by external diffusion. As particle size is reduced, intra-particle processes rapidly become more important. At sizes less than 0.1 cm (0.04 in.), intra-particle diffusion/reaction is clearly the rate determining step. The intrinsic diffusion/reaction rate (based on external surface area) was found to have an apparent order of 0.6 in oxygen and an effective activation energy of 11.5 kcal/g-mole. It is hypothesized that the unusually low activation energy results from the effect of heating rate on internal surface area and/or catalysis due to inorganic impurities in the char. There is also evidence that the intra-particle resistance to diffusion is very low, requiring a diameter dependent term in the intrinsic reaction rate expression. 19 references, 13 figures, 5 tables.

113 **(DOE/MC/14368—1462) Modeling of nitrogen pollutants in turbulent pulverized-coal flames. Final report, July 1, 1980-June 30, 1983.** Hill, S.C.; Smoot, L.D.; Smith, P.J. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 20 Jul 1983. Contract AC21-80MC14368. 166p. NTIS, PC A08/MF A01. Order Number DE84000227.

This volume summarizes a three-year theoretical study of pollutant formation in pulverized-coal systems, with an emphasis on nitrogen pollutants. A NO pollutant model has been formulated to be consistent with the assumptions made in current comprehensive models for fuel-rich turbulent pulverized-coal flames. The model accounts for the effects of turbulent fluctuations on the pollutant formation process. The pollutant species equations are decoupled from the overall velocity, temperature and major species field equations. The fuel nitrogen is assumed to evolve from the coal at a rate proportional to coal weight loss, and to react quickly to HCN in the gas phase. The homogeneous rate of decay of HCN to NO or N_2 includes the effects of turbulent fluctuations to obtain a time-mean reaction rate. Heterogeneous reduction of the NO is modeled by a slow (non-fluctuating) rate. Thermal and prompt NO are considered to be insignificant in these fuel-rich coal flames, and only fuel nitrogen formation is considered. The time-mean reaction rates are obtained by assuming that the species mass fractions are linear functions of stoichiometry, and then integrating the resulting kinetic expression over the probability density functions for the appropriate mixture fractions. Computations are presented to demonstrate the applicability of the theory to practical coal combustion chambers. An analysis of the NO model was performed to determine the effect of various physical and inlet parameters on model predictions. Model evaluation has consisted of detailed local comparisons of model predictions with experimental data, and comparison of predicted and observed trends related to pollutant formation in coal systems. Additional applications of the NO model were also illustrated. 116 references, 57 figures, 12 tables.

114 **(DOE/PC/30238—1) Modification of coal fly ash size distribution. Semiannual technical progress report No. 1, August 1, 1980-January 31, 1981.** Clark, R.D.; Sveum, L.K. (New Mexico Highlands Univ., Las Vegas (USA). Div. of Science and Mathematics). 15 Mar 1981. Contract FG22-80PC30238. 19p. NTIS, PC A02/MF A01. Order Number DE84002527.

A study of coal fly ash formation was initiated on August 1, 1980. The specific objectives of the study are to modify coal fly ash particle size distribution by changes in furnace gas composition and additives to the coal. Coal and ash from two power plants have been obtained for this project. One plant is located in North Dakota and burns lignite coal while the other is located in Northwestern New Mexico and burns subbituminous coal. A laboratory scale coal combustor is being constructed using a two-inch tube furnace as the heat source, and capable of utilizing pulverized coal form either a screw feeder or a fluidized bed. The gas composition in the furnace is variable; and ash particles may be collected on a point-to-plane electrostatic precipitator, a cascade impactor, or a cyclone train for particle sizing and characterization. Fundamental studies of the thermal properties of fly ash and fly ash minerals are being conducted by Differential Thermal Analysis. Preliminary data suggest that fly ash has a glass transition temperature of 900° with melting and bubbling at 1400°C. 5 references, 2 figures, 1 table.

115 **(DOE/PC/30238—2) Modification of coal fly ash size distribution. Annual technical progress report No. 1, August 1, 1980-July 31, 1981.** Clark, R.D.; Sveum, L.K. (New Mexico Highlands Univ., Las Vegas (USA). Div. of Science and Mathematics). 29 Sep 1981. Contract FG22-80PC30238. 36p. NTIS, PC A03/MF A01. Order Number DE84002530.

A study of coal fly ash formation was initiated on August 1, 1980. The specific objectives of the study are to modify coal fly ash particle size distribution by changes in furnace gas composition and additives to the coal. Coal from four power plants and ash from 14 power plants has been obtained for use in this project. A laboratory scale coal combustor has been constructed using a two-inch tube furnace as the heat source. Ash samples may be collected on a point-to-plane electrostatic precipitator, a cascade impactor, or a cyclone train for particle sizing and characterization. Fly ash particles varying from rock fragments at low burner temperature to solid spheres and cenospheres at high temperatures have been obtained with the laboratory burner. Fundamental studies of the thermal properties of fly ash and fly ash minerals are being conducted by differential thermal analysis (DTA). The DTA traces in general are quite complexas might be expected if the ash is composed of a variety of minerals; however, the DTA traces can be characterized as having an initial exotherm with a peak at 500 to 600° followed by a broad endotherm with a valley in the 1000 to 1500° range. The endotherm has a number of small exotherms superimposed on it. Some generalizations can be made: when coal from the same mine is burned in different combustors, the thermal behavior of the ash is very similar. Ash obtained from different coal sources has different melting behavior. A subtle shift of peaks to higher temperature with larger ash particle size has been observed. 7 references, 6 figures, 7 tables.

116 **(DOE/PC/30238—3) Modification of coal fly ash size distribution. Semiannual technical progress report No. 3, August 1, 1981-January 31, 1982.** Clark, R.D.; Sveum, L.K. (New Mexico Highlands Univ., Las Vegas (USA). Div. of Science and Mathematics). 5 Apr 1982. Contract FG22-80PC30238. 26p. NTIS, PC A03/MF A01. Order Number DE84002529.

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This report summarizes the technical progress during the third semiannual period of a two-year study of coal fly ash formation. The objective of this project is to control the particle size distribution of coal fly ash by modifying the process by which particles are formed. Specifically, we are investigating two hypotheses for modifying fly ash size. These are: (1) the formation of hollow spheres in fly ash is related to the gas composition in the furnace, particularly oxygen to nitrogen ratio; (2) the fusion temperature, which determines whether hollow spheres are formed, can be modified by altering the mineral composition of the coal. A laboratory scale coal combustor has been constructed using a two-inch tube furnace as the heat source with a fluidized bed coal feeder. Ash samples may be collected on a cascade impactor for particle sizing and characterization. Fundamental studies of the thermal properties of fly ash and fly ash minerals are being conducted by differential thermal analysis. 3 references, 5 figures, 1 table.

117 **(DOE/PC/40267—4) Combustion characterization of coals for industrial applications. Fourth quarterly progress report, January 1-March 31, 1983.** Nsakala, N.; Patel, R.L.; Lao, T.C. (Combustion Engineering, Inc., Windsor, CT (USA)). Jun 1983. Contract AC22-81PC40267. 18p. NTIS, PC A02/MF A01. Order Number DE83013604.

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The Controlled Mixing History Furnace (CMHF) testing of the Alabama high volatile A bituminous coal was completed in December 1982. The main goal of the CMHF testing is to determine the effect of staged combustion on NO/sub x/ emissions control and its influence on overall combustion efficiency and to provide scale up information for extrapolating Drop Tube Furnace System results. The parameters studied include: (1) primary stage stoichiometry, (2) primary stage residence time, and (3) overall excess air level. In addition, one test was conducted on a finer grind coal (87% through 200 mesh) under optimum NO/sub x/ conditions to study the effect of particle size on NO/sub x/ emissions and carbon burnout. Based on this pilot scale study on the Arkadelphia coal, it can be concluded that a judicious use of staged combustion leads to an effective control of NO/sub x/ emissions without adversely affecting the overall fuel combustion efficiency. Specific conclusions follow. Both primary stage stoichiometry and primary stage residence time are very important parameters for controlling NO/sub x/ emissions. At 20% overall excess air: (1) an optimum primary stage stoichiometry of 50% of theoretical air, at a primary stage residence time of 1.45 seconds brought about a 43% reduction in NO/sub x/ compared to the unstaged baseline case; and (2) a primary stage residence time of 1.56 seconds, at a primary stage stoichiometry of 50% led to a 50% reduction in NO/sub x/ compared to the same unstaged baseline case. The effect of excess air on NO/sub x/ emissions under an optimum primary stage stoichiometry condition is moderate but significant. Increasing the excess air from 0 to 35%, while holding the primary stage stoichiometry constant at 50%, led to an increase in NO/sub x/ of 27%. 8 figures, 2 tables.

118 **(PB—83-247247) Control of criteria and non-criteria pollutants from coal/oil mixture combustion. Final report feb 81-feb 82.** Kelly, M.E.; Parks, R.M.; Stelling, J.H.E. (Radian Corp., Durham, NC (USA)). Aug 1983. 211p. NTIS, PC A10/MF A01.

The report summarizes the existing data base on NOx, SO2, and particulate emissions from combustion sources burning coal/oil mixtures (COMs). The need for the U.S. to reduce its dependence on oil and expand its use of coal has prompted a number of industrial and utility energy producers to investigate converting their sites from the exclusive combustion of oil to combustion of COMs. Under contract to EPA and DOE, Radian has identified and evaluated emission control technologies that could be retrofitted to boilers to control criteria and non-criteria air pollutants. The report also gives emissions data for the trace elements As, Be, Cd, Cr, Hg, Ni, Se, and V. It identifies control techniques that can reduce the emissions of these pollutants. These techniques are assessed for their efficiency to reduce the emissions from COM combustion to levels representative of oil firing. Capital costs, operating expense, and overall lifecycle costs are also discussed.

119 **New research zeroes in on fluid-bed design.** Chowdhury, J. *Chemical Engineering (New York);* **90**: No. 13, 17-19(27 Jun 1983).

Research and development projects on atmospheric fluidised-bed combustion systems in the US are described. The work is sponsored by the Department of Energy and relates to seven design concepts.

120 **Volatilization/condensation of alkali salts in a pressurized fluidized bed coal combustor/gas turbine combined cycle.** Spacil, H.S.; Luthra, K.L. (General Electric Company, Corporate Research and Development, Schenectady, New York). *Journal of the Electrochemical Society;* **129**: No. 9, 2119-2126(Sep 1982). Contract AC21-76ET10377.

Thermochemical models are used to predict the behavior of sodium and potassium contaminants in a pressurized fluidized bed coal combustor (PFBC)/gas turbine (GT) combined cycle. The alkalis, originating from the coal and dolomite (or limestone) in the bed, exist in the combustion gases primarily as their chlorides. They subsequently condense in the gas turbine as sulfates. The amounts of sulfates deposited may be about two orders of magnitude higher than those normally encountered in oil-fired gas turbines. The results of the calculations compare well with the few experimental data available at present.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 8, 94

121 **(DOE/EIA—0121(83/2Q)) Quarterly coal report, April-June 1983.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 20 Oct 1983. 89p. NTIS, PC A05/MF A01 - GPO. Order Number DE84002531.

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The historical data in this report are collected using three quarterly coal surveys - of manufacturers consuming coal, of companies distributing coal, and of coke plants - and two monthly surveys of electric utilities. In addition, data from the annual survey of coal mines appear in Appendix B, Annual Trends. All data for 1982 and previous years are final. All 1983 data are preliminary and subject to revision.

122 **(NP—4900178) Effect of increases in energy-related labor forces upon retailing in Alabama.** Robicheaux, R.A. (Alabama Univ., University (USA). School of Mines and Energy Development). Jun 1983. 48p. NTIS, PC A03/MF A01. Order Number DE84900178.

The heightened mining employment that will result from increased extraction of coal from Alabama's Warrior Coal Basin will boost retail sales and employment. The Warrior Coal Basin counties (Fayette, Jefferson, Tuscaloosa and Walker) are heavily dependent upon coal mining as a source of employment and wages. Further, since the counties' economies grew increasingly dependent upon coal mining activities throughout the 1970s, it was believed that it would be possible to measure, with some acceptable level of reliability, the impact of the steadily rising mining activity upon the area's retailing sector. Therefore, a small scale econometric model was developed which represents the interrelationships among income, mining and trade employment and retail sales in the four-county Warrior Coal Basin area. The results of two versions of the model are presented. In the first version, area-wide retail sales are treated in the aggregate. In the second version, retail sales are disaggregated into twelve categories (e.g., food, apparel, furniture, etc.). The models were specified using 1960 to 1976 data. The mining employment growth scenario used in this report called for steady increases in mining employment that culminated in an employment level that is 4000 above the baseline employment projections by 1985. Both versions of the model predicted that cumulative real regional income would increase by $1.39 billion over seven years with the added mining employment. The predicted impacts on trade employment and real retail sales varied between the two models, however. The aggregate model predicts the addition of 7500 trade workers and an additional $1.35 billion in real retail sales. The disaggregate model suggests that food stores, automobile dealers, general merchandise stores, gas stations and lumber and building materials retailers would enjoy the greatest positive benefits.

0160 Health And Safety

REFER ALSO TO CITATION(S) 6, 7

123 **(CONF-821048—4) Life sciences research in support of fossil-fuel technologies: reflections and a look forward.** Richmond, C.R. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE84001944.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

In this welcoming address to the fifth ORNL Life Sciences Symposium on Synthetic Fossil Fuel Technologies the author summarizes issues, information needs and policy options in the areas of environmental research and development and health effects research and development, and recommends a troika approach to the development of new technology that includes a determination of environmental acceptability. (ACR)

124 **(CONF-8210100—3) Industrial hygiene monitoring for evaluation of employee exposure and control measures in coal conversion program at Oak Ridge National Laboratory.** Dreibelbis, W.G.; Ealy, J.A.; Porter, W.E. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE84001940.

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

The Oak Ridge National Laboratory has been actively engaged in a coal-conversion technology program since 1974. Since that time the industrial hygiene group has closely monitored the several different phases of this bench-scale and pilot-plant-scale program. During late 1979 and early 1980, industrial hygiene monitoring was increased significantly, both in terms of sampling frequency and number of workroom air contaminants sampled for. Many special samples and samples for contaminants not normally expected have been collected. The sampling methods and analytical techniques used are described in detail, as well as results of area and personal air sampling. Routine control measures employed in various coal-conversion facilities at ORNL are also discussed. 6 tables.

125 **(CONF-8210100—4) PAH-contaminated materials management at Oak Ridge National Laboratory.** Braunstein, H.M.; Eisenhower, B.M.; Dreibelbus, W.G. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01. Order Number DE84001989.

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

Research at a large experimental facility such as the Oak Ridge National Laboratory (ORNL) involves a very wide assortment of technological, health, environmental, and analytical studies, many of which have the potential for generating hazardous materials. For example, studies involving the conversion of coal into usable, substitute energy products produce gas, liquid, and solid streams, many of which contain coal-derived organic compounds capable of causing adverse environmental and health effects. Because experiments are unlike one another and because each experiment involves varying conditions, the materials being handled and requiring disposal are unpredictable in amounts, frequency of generation, and composition. Thus, in structuring programs such as the coal technology program at Oak Ridge National Laboratory, activities such as personnel monitoring and management of waste streams are built into the research planning and activities. PAH-contaminated materials management at ORNL utilizes a variety of techniques, both administrative and technical, to simplify situational problems, to satisfy regulatory, cost, and operational constraints, and to accommodate the researcher. The Laboratory's experience with hazardous materials handling and monitoring, although not entirely problem-free, should be a valuable addition to other workplace experiences.

126 **(ORNL/TM—8753) Development of a portable fluorescence monitor to detect surface contamination by polycyclic aromatic hydrocarbons.** Burtis, C.A.; Mrochek, J.E. (comps.). (Oak Ridge National Lab., TN (USA)). Nov 1983. Contract W-7405-ENG-26. 56p. NTIS, PC A04/MF A01. Order Number DE84002390.

A portable fluorometer, termed the spill spotter, has been developed to monitor for surface and skin contamination by polycyclic aromatic hydrocarbons (PAHs) in fossil energy conversion facilities. The spill spotter operates by optically exciting the PAH molecules then measuring the resultant fluorescence. The apparatus consists of two cable-linked, hand-held components: an optics unit and an electronics module. The spill spotter can be operated either with 110-V ac electric current or with rechargeable batteries by exchanging the top cover of the electronics module. The optics unit emits a beam of intensity-modulated ultraviolet light for excitation and detects the resultant fluorescent by phase-sensitivity. Easily exchanged excitation and emission filters in the unit provide for selective detection of various classes of organic compounds, and its sensitivity to the phase of the signal enables discrimination of the fluorescence of organic compounds from the longer-lived luminescence of inorganic compounds. The spill spotter has been extensively evaluated by Oak Ridge National Laboratory (ORNL) and through field testing in coal conversion plants. It has been found suitable for monitoring both production areas for PAH spills and personnel for skin contamination. Recent studies with hairless mice demonstrated a dose-response relationship. An improved prototype was fabricated and subsequently field tested by personnel of Ashland Synthetic Fuels, Inc. at the H-Coal Pilot Plant in Catlettsburg, Kentucky. In 1980, the spill spotter earned an IR-100 Award as one of the 100 most significant technical developments for that year. 8 references, 16 figures, 10 tables.

127 **(PB—83-237446) Short-term prospective spirometric study of new coal miners.** Hankinson, J.L.; Hodous, T.K. (National Inst. for Occupational Safety and Health, Morgantown, WV (USA)). Sep 1982. 79p. NTIS, PC A05/MF A01.

This study examined prospectively a small cohort (N=116) of new coal miners with questionnaires and spirometry. Data collection began just prior to underground employment and extended over a two year period at 6 month intervals to address the question or short-term adverse occupational pulmonary effects and their relationship to outward migration from the industry. A comparison of the initial (unexposed) and six month (exposed) changes in lung function over the work shift was also conducted to detect an acute effect due to dust, which might be related to chronic decline in lung function.

0170 Legislation And Regulations

128 **(DOE/RG—0061) Powerplant profiles.** (USDOE Economic Regulatory Administration, Washington, DC. Office of Fuels Programs). Mar 1983. 188p. NTIS, PC A09/MF A01. Order Number DE84001240.

The Energy Supply and Environmental Coordination Act of 1974 (ESECA) and Fuel Use Act of 1978 (FUA) were enacted to promote the use of coal and other alternate fuels in place of petroleum and natural gas. Under both laws, DOE is authorized to prohibit certain existing powerplants from using petroleum and natural gas as primary energy sources. Prohibition orders provide certain preferential treatment under the Clean Air Act to converting powerplants. The profiles presented in this document are organized into four categories: (1) powerplants with recently finalized ESECA and FUA prohibition orders, (2) powerplants with pending ESECA prohibitions orders, (3) powerplants with pending FUA proposed prohibition orders, and (4) other powerplants which are being or could be converted to coal-burning. The last group is made up of powerplants that had FUA or ESECA prohibition orders which expired (after OBRA), that have been or are being voluntarily converted, and/or that are being studied for conversion. The data, views and perceptions presented in the profiles are based on DOE staff interpretations of various documents and communications (both written and oral) between federal agencies, state and local authorities, and utilities. Accordingly, information provided in this document may not always reflect official positions.

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 176

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 137, 1390, 1392

129 (CONF-821199—, pp 76-78) **Considerations for research on compaction of oil producing reservoirs.** Prats, M. (MARAVEN, Caracas, Venezuela). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

Although compaction results in the deformation of the reservoir and its overlying formations, it can be an important oil production mechanism. The challenge is to do the utmost in making use of compaction as a commercial oil-producing mechanism in a socially acceptable manner, and while maintaining control of the operation. From a reservoir operations point of view, a research program or compaction should: (1) stress the development of methods and techniques for the early identification of the presence of significant latent compaction, and (2) distinguish between the need to identify the presence of significant latent compaction at an early stage. 1 figure.

130 **(DOE/ER/10837—3) Experimental formation of chalk from calcareous ooze. Final report, February 15, 1981-October 14, 1983.** Seyfried, W.E.; Johnson, T.C. (Minnesota Univ., Minneapolis (USA)). Oct 1983. Contract AC02-81ER10837. 16p. NTIS, PC A02/MF A01. Order Number DE84001128.

Hydrothermal experiments on three calcareous oozes of different compositions were performed at the University of Minnesota in a flow-through apparatus and a squeezer assembly. Both apparati allow unconsolidated sediment to be compacted and dewatered in the experimental cell. Sediments in the flow-through system were exposed to 300 bars differential pressure, 100 bars pore pressure; those in the squeezer assembly were exposed to 400 bars confining pressure and little pore pressure. Experiments lasted two weeks at 150°C. The initial pore fluid was a Mg and SO4- free artificial seawater. The presence of Mg, Sr and Ba in the reacted pore fluid reflected Ca-X exchange and the replacement of less stable carbonate phases, while exchange reactions with clays introduced elements such as Si and Fe into the pore fluid. Initial porosity reduction due to compaction was furthered by pressure solution; fragile coccoliths dissolved while solution-resistant forms became more abundant. Comparison of in-situ permeability measurements performed in the flow-through system with measurements on dry cores shows that the drying process produces permeability increases due to physical changes in the rock.

131 **(N—8323795) Reservoir anatomy and additional oil recovery.** Fisher, W.L. (Texas Univ., Austin (USA)). May 1982. 6p. NTIS, PC A03/MF A01.

In Keplinger and Associates, Inc. The Impact of Geol. Parameters on Enhanced Oil Recovery p 8-13 (SEE N83-23794 13-44).

The ability to take detailed reservoir data and reconstruct in three dimensions the anatomy of a reservoir, that is, to define the plumbing of flow paths within the reservoir, are addressed.

132 **(N—8323796) Rock-fluid Interaction Workshop.** (Keplinger and Associates, Inc., Tulsa, OK (USA)). May 1982. 5p. NTIS, PC A03/MF A01.

In Impact of Geol. Parameters on Enhanced Oil Recovery p 14-18 (SEE N83-23794 13-44).

Research areas relating geologic studies to an improved understanding of the various EOR processes and their interaction with reservoir minerals are discussed. Of primary concern were the interactions of EOR fluids with the pore surfaces within the reservoir rock.

133 **(N—8323797) Reservoir Heterogeneity Workshop.** (Keplinger and Associates, Inc., Tulsa, OK (USA)). May 1982. 5p. NTIS, PC A03/MF A01.

In Impact of Geol. Parameters on Enhanced Oil Recovery p 19-23 (SEE N83-23794 13-44).

The adequacy of data and geologic models in the public domain in characterizing geologic heterogeneities of reservoirs, a model of heterogeneities based on surface geology (outcrop) to predict reservoir properties, interpretation of data from existing tools and improved tools for determining geologic heterogeneities, performance of fluid movement in heterogenous media, minimizing effects of geologic heterogeneities on EOR, and the potential for infill drilling are summarized.

134 **(N—8323798) Reservoir Description Workshop.** (Keplinger and Associates, Inc., Tulsa, OK (USA)). May 1982. 6p. NTIS, PC A03/MF A01.

In Impact of Geol. Parameters on Enhanced Oil Recovery p 24-29 (SEE N83-23794 13-44).

The task of identifying those areas where geologic and engineering data have not been utilized to their fullest extent in EOR applications, and to recommend research topics to remedy their deficiency was undertaken.

135 **(N—8324927) Significance of the Mesozoic carbonate bank-reef sequence for the petroleum geology of the Georges Bank Basin.** Mattick, R.E. (Geological Survey, Washington, DC (USA)). 1982. 12p. NTIS, PC A09/MF A01.

In Geol. studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer continental Shelf p 93-104 (SEE N83-2491 14-42).

The development of the continental shelf margin during Jurassic time is analyzed and an effort is made to show the relationship between carbonate facies, which may or may not be signifi-

cantly porous, and basinal facies, which may contain large amounts of marine-derived organic carbon. Areas in which these facies are in proximity may prove to be areas where significant amounts of petroleum have accumulated in stratigraphic traps.

136 **(N—8324928) Organic geochemistry of the Georges Bank Basin COST Nos. G-1 and G-2 wells.** Miller, R.E.; Lerch, H.E.; Claypool, G.E.; Smith, M.A.; Owings, D.K.; Ligon, D.T.; Eisner, S.B. (Geological Survey, Washington, DC (USA)). 1982. 38p. NTIS, PC A09/MF A01.

In Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer Continental shelf p 105-142 (SEE N83-24921 14-42).

The source-rock characteristics of the stratigraphic intervals that may be considered prospects for the generation of oil or natural gas in the COST Nos. G-1 and G-2 wells from the Georges Bank basin are compared. The depth of burial required for the onset of thermal maturation processes is assessed and the geochemical effects that mud additives may have on the source-rock interpretations are evaluated.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 129, 132, 183, 184, 185, 1397

137 **(CONF-821199—, pp 58-64) Geopressures: significance and implications to the petroleum industry.** Chilingar, G.V.; Fertl, W.H.; Yen, T.F. (Univ. of Southern California, Los Angeles). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The authors dicuss the significance of abnormal geopressures to the petroleum industry. Occurrence and detection of overpressured subsurface formations are critical in exploration, drilling, and production operations. Hence, an interdisciplinary approach is required to optimize the safety, engineering, and economical aspects. Worldwide experience in both on and offshore areas indicates a significant correlation between formation pressures and the shale/sand ratio of sedimentary sections. Distrbibution of oil and gas is related to regional and local subsurface pressure and temperature environments. Knowledge of the expected pore pressure and fracture gradients is the basis for efficiently drilling wells with correct mud weights, properly engineered casing programs, and proper well completions that are effective and safe. In reservoir engineering, formation pressures influence compressibility and the failure of reservoir rocks, and can be responsible for water influx from adjacent overpressured shale sections as an additional driving mechanism in hydrocarbon production. Furthermore, statistical correlations have been developed between a shale-resistivity profile, and the distribution of economically significant hydrocarbon resources. Pore-fluid pressures in excess of hydrostatic pressures have been encountered in formations ranging in geologic age from the Cenozoic era (Pleistocene) to as old as Paleozoic era (Cambrian). Such pressures may occur from a few hundred feet below the surface to depths exceeding 25,000 feet (7620 m) and can be present in shale-sand sequences and/or massive carbonate-evaporite sections. In the worldwide search for hydrocarbon resources, abnormal formation pressures have been encountered on all continents and many shelf areas. 9 figures, 3 tables.

138 **(DOE/BC/00047—T4) Development of improved mobility control agents for surfactant/polymer flooding. Final report.** Martin, F.D.; Donaruma, L.G.; Hatch, M.J. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). May 1982. Contract AC19-78BC00047. 107p. NTIS, PC A06/MF A01. Order Number DE84001873.

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The goal of the laboratory work in this project was to develop mobility control agents that are more effective than the polymers currently used in surfactant/polymer flooding applications. This report summarizes the progress made during each phase of the project. During the first year, the initial phase of the project included a literature survey of surfactant/polymer flooding, a summary of the current status of DOE-sponsored polymer and surfactant/polymer field projects, and a survey of oil industry personnel regarding difficulties encountered in the use of commercially available polymers. The purpose of Phase 1 of the project was to delineate clearly the strengths and weaknesses of the commercial polymers. The laboratory tests in the second phase then were designed to measure and compare the factors considered to be of greatest importance. During the second year of the project, the Phase 2 baseline screening tests were completed, and Phase 3 work commenced on the synthesis, characterization, and preliminary screening of new or modified polymers. These results were presented in our second annual report. During the final year of the project, the preliminary screening tests were completed and polymers of interest were evaluated in more detail. This final report contains highlights of the significant accomplishments of the project and presents our conclusions regarding the development of improved mobility control agents. Our work has shown that moderate changes in the basic structure of acrylamide polymers can produce significant effects on performance in oil recovery applications. Better viscosity retention in brine can be obtained by stiffening the polymer chain of acrylamide-type materials. Enhanced shear stability can be attained by increasing the polymer hydrophilicity. Future research should be directed along these lines. 28 references, 30 figures, 37 tables.

139 **(DOE/BC/10033—8) Evaluation of the Wilmington Field micellar-polymer project.** Fanchi, J.R.; Duane, N.C.; Hill, C.J. (Keplinger and Associates, Inc., Tulsa, OK (USA)). Oct 1983. Contract AC19-80BC10033. 113p. NTIS, PC A06/MF A01. Order Number DE84001631.

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A review of the performance of the City of Long Beach micellar-polymer pilot has been completed. The pilot area was the Hx/sub a/ sand of the Upper Terminal VB Zone in the Wilmington Field. The Upper Terminal producing zone is an unconsolidated oil-bearing sandstone. Oil production from the Upper Terminal zone had been steadily declining despite pressure maintenance programs initially using gas injection and, most recently, waterflooding. The micellar-polymer pilot was an attempt to find a means of arresting the decline of oil production. Marathon Oil Company provided the City of Long Beach with a micellar-polymer - Maraflood (TM) - design. The projected oil recovery beyond waterflooding for the Maraflood (TM) process is about 137,000 barrels, or 10% pore volume, of incremental oil. This recovery is approximately two-thirds of expected recovery based upon core flood results and a simple simulation model evaluation of volumetric sweep efficiency. The model study assumed optimal phase behavior was achieved and tertiary oil was displaced by a unit mobility flood. A more sophisticated chemical flood simulator could have been used; however, its results would have been easily challenged because quantitative phase behavior and rheological data were not available. The actual recovery efficiency is high when compared with the recovery efficiency estimated from core flood and simulation model results. Consequently, the project appears to be a technical success. Unfortunately, the project must be considered uneconomic based upon a total project cost of around $9.7 million. The poor economics are attributed to operating problems associated with fluid production from an unconsolidated sand and corrosion problems due to the presence of Desulfovibrio bacteria. 17 references, 41 figures, 26 tables.

140 **(DOE/BC/10300—34) Use of microorganisms in enhanced oil recovery. First annual report, October 1, 1980-September 30, 1982.** McInerney, M.J.; Menzie, D.E.; Jenneman, G.E.; Knapp, R.M. (Oklahoma Univ., Norman (USA)). Sep 1983. Contract AS19-80BC10300. 59p. NTIS, PC A04/MF A01. Order Number DE84001027.

Twenty-two isolates were obtained that produced bioemulsifiers or biopolymers when grown in a sucrose, 5% NaCl mineral salts medium at 50 C. Biopolymers were produced aerobically and anaerobically. Bacillus licheniformis, strain JF-2 cultures had the lowest surface tensions of the eleven bioemulsifer-producing isolates tested. Growth of strain JF-2 was not affected by NaCl concentrations up to 10%, pH values of 4.6 to 9.0, temperatures up to 50 C or the presence of crude oil. The surfactant produced by strain JF-2 was not affected by the pH, temperature, NaCl or calcium concentrations found in many oil reservoirs. These properties indicate that the surfactant produced by strain JF-2 has many properties

suitable for enhanced oil recovery processes. The success of in situ microbial plugging process depends on the ability to transport the microbes throughout the reservoir, to transport the nutrients required for growth, and to selectively reduce the apparent permeability of the reservoir as a result of microbial growth and metabolism. Nutrients such as glucose, ammonia, nitrogen and phosphate were transported through Berea sandstone cores in amounts sufficient to support microbial growth. Viable bacterial cells in brine solution were transported through sandstone cores with permeabilities as low as 196 md. Continuous nutrient injection resulted in almost complete blockage of fluid flow while batch addition of nutrients resulted in permeability reductions of 60 to 80% of the initial value. Indigenous microbial populations accounted for 50 to 70% of these permeability reductions. Effluent of cores that received nutrients had large numbers of viable cells indicating that growth may be a mechanism to transport the cells through the rock. Electron microscopy indicates that the plugging by bacteria may involve the aggregation of clays and other insoluble materials with the bacterial biomass. 45 references, 16 figures, 7 tables.

141 **(DOE/BC/10304—17) Biodegradation of materials used in enhanced oil recovery. Final report, July 1, 1978-November 30, 1981.** Grula, M.M.; Grula, E.A. (Oklahoma State Univ., Stillwater (USA)). Sep 1983. Contract AS19-80BC10304. 88p. NTIS, PC A05/MF A01. Order Number DE84002019.

Although the importing of oil by the United States has declined in the last two years, there is still a great deal of interest in enhanced oil recovery (EOR) from domestic oil fields. At least two of the technologies used in EOR, viz., polymer flooding and micellar-polymer flooding, involve the use of chemical agents. With the prospect of substantially increased application of such agents in enhanced recovery operations in the future, it is important to have information on the potential environmental impact of their heavy or widespread use. A major environmental impact could result from spills occurring during the transportation, preparation of solutions, storage, or handling of the chemicals. The degree of this impact would be largely a reflection of the ability of soil microflora to degrade the chemicals used in EOR. Failure of degradation within a reasonable time could result in toxicity for microbes, plants, or even animals, thus leading to environmental deterioration. The goals of this work are: (1) to obtain information on biodegradability of various chemicals used in EOR technologies under conditions similar to those found in the field; (2) to determine toxicities of EOR chemicals for a representative group of bacteria; (3) to determine the effects of environmental parameters on readiness of biodegradation; and (4) in the case of mixtures, to determine the relative rates of degradation of various components. 20 references, 20 figures, 49 tables.

142 **(DOE/BC/10355—1) Environmental regulations handbook for enhanced oil recovery. 1983 update.** Wilson, T.D. (Spears and Associates, Inc., Tulsa, OK (USA)). Oct 1983. Contract AC19-80BC10355. 204p. NTIS, PC A10/MF A01. Order Number DE84002003.

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This handbook is intended to serve owners and operators of enhanced oil recovery operations as a guidebook to the environmental laws and regulations which have special significance for enhanced oil recovery (EOR). EOR, as used in this handbook, refers to what is also called tertiary recovery. There are three major categories of EOR processes - thermal (including both steam injection and in-situ combustion), miscible gas, and chemical. These processes are used only after a well or reservoir has ceased to produce oil economically through primary or secondary methods. The primary emphasis in the handbook is on laws and regulations for the control or prevention of pollution. 3 figures, 14 tables.

143 **(DOE/ET/12015—62) Tertiary oil recovery by carbon dioxide injection, Granny's Creek Field, West Virginia. Final report.** Conner, W.D. (Columbia Gas Transmission Corp., Charleston, WV (USA)). Oct 1983. Contract AC05-76ET12015. 40p. NTIS, PC A03/MF A01. Order Number DE84002601.

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During the period June 1976 through June 30, 1980, a field demonstration of oil recovery by CO_2 injection in Clay County, West Virginia was conducted. The objective of this test was to demonstrate and evaluate the effectiveness of using CO_2 injection to recover high gravity crude oil from shallow watered-out reservoirs. The project eventually developed into two distinct phases: the first being CO_2 injection into four corner wells in a conventional five-spot, with a central producing well and three interior test/observation wells. The second phase of the project consisted of a mini-flood within the original pattern. A total of 9800 tons of CO_2 was injected into the five-spot in several stages, alternating with water periodically for mobility control and better sweep efficiency. Injection of the CO_2 slug was completed on June 16, 1977. Water injection followed the CO_2 slug until the pattern was effectively watered-out. Oil production from the central producer peaked shortly after cessation of CO_2 injection and water production increased to about the same as before the project started. Since it was felt that the project lacked confinement as evidenced by extensive CO_2 migration outside the pattern and the low recoveries, a series of reservoir interference tests were run to help determine the best course of action to follow. The mini-test resulted. Approximately 1600 tons of CO_2 were injected during this phase. Oil production within the pattern during the first phase amounted to approximately 4000 bbls. while during the mini-flood an additional 1345 bbls. of oil was produced. It has been extremely difficult to evaluate this project due to the extremely complex heterogeneity of the reservoir. The problem has been compounded by the many workovers experienced by the wells over the years, and the resultant damage to the reservoir. 7 references, 12 figures, 13 tables.

144 **(LBL—16430) Seven-point finite difference method for improved grid orientation performance in pattern steam floods.** Pruess, K.; Bodvarsson, G.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 35p. (CONF-831190—2). NTIS, PC A03/MF A01. Order Number DE84001912.

From 7. Society of Petroleum Engineers reservoir simulation symposium; San Francisco, CA, USA (15 Nov 1983).

This paper presents a novel seven-point finite difference approximation for simulations of adverse mobility ratio displacements. The method is based on partitioning of a two-dimensional flow domain into regular or nearly regular hexagons. The accuracy of the method for pattern steam floods of heavy oil reservoirs is compared to five- and nine-point approximations. For five-spot floods, the accuracy of the seven-point method is good and comparable to that of the nine-point scheme. For seven-spot floods, the seven-point method provides good numerical accuracy at substantially less computational work than five- or nine-point methods. For nine-spot floods, only the nine-point method is found to give accurate results. 16 references, 10 figures, 3 tables.

145 **(LBL—16587) Numerical solution of the Buckley-Leverett equations.** Sethian, J.; Chorin, A.J.; Concus, P. (Lawrence Berkeley Lab., CA (USA)). Sep 1983. Contract AC03-76SF00098. 31p. (CONF-831190—1). NTIS, PC A03/MF A01. Order Number DE84001877.

From 7. Society of Petroleum Engineers reservoir simulation symposium; San Francisco, CA, USA (15 Nov 1983).

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A modified random choice method is described for solving simultaneously the Buckley-Leverett, incompressibility, and Darcy's Law equations for immiscible displacement in a porous medium. The main idea of the numerical method is to modify the one-dimensional Riemann solvers in the split random choice method so that the multidimensional flow is represented correctly. Other features include flux conserving differencing of pressure and velocity and an accurate description of sources and sinks. Numerical results for a two-dimensional five-spot waterflood indicate that the advancing front is kept sharp by the method, that the time of breakthrough is accurate, and that grid orientation effects are unimportant. 9 references, 10 figures.

146 **(N—8323799) Instrument technology.** (Keplinger and Associates, Inc., Tulsa, OK (USA)). May 1982. 4p. NTIS, PC A03/MF A01.

In Impact of Geol. Parameters on Enhanced Oil Recovery p 30-33 (SEE N83-23794 13-44).

Surface and borehole geophysics to map the process control through selective injection/withdrawal operations are discussed. The geophysical techniques most suited to these tasks are described.

147 **(SAND—83-0145/3) Field test of two high-pressure, direct-contact downhole steam generators. Volume III. Metallurgical analyses.** Muir, J.F.; Weirick, L.J.; Pettit, F.S. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 125p. NTIS, PC A06/MF A01. Order Number DE84002704.

Two prototype downhole steam generator (DSG) systems were operated in an oil field environment during a test in the Wilmington Field, Long Beach, CA, from June 1981 through March 1982. One generator burned diesel fuel in air and was located downhole, the other burned diesel in oxygen and was operated on the surface. Components of the two systems experienced varying degrees of corrosion during the test. Severe degradation of certain critical components limited the operating lifetimes of both steam generators. Metallurgical analyses of degraded components were performed to determine the causes and mechanisms of corrosion of materials exposed to the diesel combustion, generator effluent, and downhole environments. Two separate analyses were conducted reflecting the two classes of attack mechanisms encountered in these environments, i.e., aqueous corrosion and mixed gas hot corrosion. Materials examined included plain carbon steel, 310 and 316 stainless steels, Inconel 600 and 625, and Hastelloy X. The degradation of combustor materials was caused primarily by fluctuations in the combustion environment, notably composition and temperature, at exposed surfaces. Most of the materials examined were found to be unsuitable for extended life in the environments to which they were exposed. Stainless steels, in particular, are not recommended for continued use in downhole steam generators. Other recommendations are provided, including alternate materials, design modifications, and changes in operating procedures, which should improve the lifetime of downhole steam generators. 83 references, 83 figures, 10 tables.

148 **Magnitude and detailed structure of residual oil saturation.** Chatzis, I.; Lim, H.T.; Morrow, N.R. (University of Waterloo, Ontario). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* 23: No. 2, 311-326(Apr 1983). Contract AS19-80BC10310.

Experimental results are presented that demonstrate the effect on residual oil, under water-wet conditions, of particle size, particle-size distribution, macroscopic and microscopic heterogeneities, microscopic dimensions such as ratio of pore-body to pore-throat size, and pore-to-pore coordination number. Experiments were performed in random packs of equal spheres, heterogeneous packs of spheres with microscopic and macroscopic heterogeneities, two-dimensional (2D) capillary networks having various pore geometries, and Berea sandstone. Detailed information on residual oil structure is presented, including blob-size distributions of residual oil. Major conclusions are (1) residual saturations are independent of absolute pore size, per se, in systems of similar pore geometry; (2) well-mixed two-component aggregates of spheres gave virtually the same residual saturations as random packings of equal spheres; (3) clusters of large pores accessible through small pores will retain oil; (4) high aspect ratios tend to cause entrapment of oil as a large number of relatively small blobs, each held in single pores; and (5) the role of pore-to-pore coordination number is generally secondary; hence, correlations that have been proposed between residual oil and coordination number are unreliable.

149 **Phase partitioning of anionic and nonionic surfactant mixtures.** Koukounis, C.; Schechter, R.S.; Wade, W.H. (University of Texas). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* 23: No. 2, 301-310(Apr 1983).

The efficiency of oil recovery by waterflooding can be greatly improved by the addition of judiciously selected surfactants. Under certain conditions, when surfactant solutions are mixed with oil, microemulsions are formed that may be in equilibrium with an excess oil (Type I), an excess aqueous phase (Type II), or both (Type III). The partitioning of the surfactant between those coexisting equilibrium phases is important to consider in the design of microemulsion processes for oil recovery. This is particularly true because different phases generally move at differing velocities within the pore spaces of an oil reservoir and therefore fractionation will occur in successive stages along the flow path. This leads to chromatographic separation of the surfactant molecules. The problem is complicated because all surfactant systems are blends of molecules, and chromatographic separation will result in a change in the optimal salinity of the surfactant system. Thus, a system that is initially optimized will not remain optimized during the course of the flood. To examine the question of selective surfactant partitioning, we varied the composition of oil/water/surfactant equilibrated systems so that they would pass through the optimal formulation region. The partitioning of anionic surfactants into the oil in Type I and Type III phase systems was small. Furthermore, binary and ternary mixtures of these surfactants were found to copartition; that is, little if any fractionation was detectable. Their collective behavior was intermediate between those of the pure components. Nonionic surfactants, unlike anionics, partition substantially into the oil phase in Type I and Type III phase systems. This was found to be an intrinsic property of the surfactant structure and not unique to those nonionic surfactant systems that are polydisperse. Selective fractionation also was found for polydisperse nonionic surfactants.

150 **Equilibrium phase compositions of CO_2/crude oil mixtures--part 2: comparison of continuous multiple-contact and slim-tube displacement tests.** Orr, F.M. Jr.; Lien, C.L.; Silva, M.K. (New Mexico Petroleum Recovery Research Center). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* 23: No. 2, 281-291(Apr 1983).

Results of phase composition and density measurements for CO_2/crude-oil mixtures at 32 ° C and four pressures are reported for a system in which liquid/liquid and liquid/liquid/vapor phase separations occur. The experiments demonstrate that a CO_2-rich liquid phase can contain as much as 30 wt% hydrocarbons and show that a CO_2-rich vapor phase at the same conditions extracts hydrocarbons less efficiently. Pseudoternary phase diagrams are presented that summarize the results of the detailed phase composition measurements. Results of slim-tube displacements at the same four pressures are also given. They indicate that displacement is efficient when the pressure is high enough that a liquid CO_2-rich phase appears. Predictions of the performance of the slim-tube displacements based entirely on the experimental measurements of phase compositions and densities are obtained using a simple one-dimensional (1D) simulator. The simulation results clarify the roles of phase behavior and volume change on mixing in the slim-tube tests. Finally, the advantages and limitations of the slimtube and continuous multiple-contact (CMC) tests are compared. The authors conclude that the CMC experiment yields more information useful for prediction of the performance of a CO_2 flood.

151 **Magnitude and detailed structure of residual oil saturation.** Chatzis, I.; Lim, H.T.; Morrow, N.R. (New Mexico Inst. of Mining & Technology). *SPEJ, Society of Petroleum Engineers Journal;* 23: No. 2, 311-326(Apr 1983). Contract AS19-80BC10310.

Experimental results are presented that demonstrate the effect on residual oil, under water-wet conditions, of particle size, particle-size distribution, macroscopic and microscopic heterogeneities, microscopic dimensions such as ratio of pore-body to pore-throat size, and pore-to-pore coordination number. Experiments were performed in random packs of equal spheres, heterogeneous packs of spheres with microscopic and macroscopic heterogeneities, two-dimensional (2D) capillary networks having various pore geometries, and Berea sandstone. Detailed information on residual oil structure is presented, including blob-size distributions of residual oil. Major conclusions are: residual saturations are independent of absolute pore size, per se, in systems of similar pore geometry; well-mixed two-component aggregates of spheres gave virtually the same residual saturations as random packings of equal spheres; clusters of large pores accessible through small pores will retain oil; high aspect ratios tend to cause entrapment of oil as a large number of relatively small blobs, each held in single pores; and the role of

pore-to-pore coordination number is generally secondary; hence, correlations that have been proposed between residual oil and coordination number are unreliable.

152 **Phase partitioning of anionic and nonionic surfactant mixtures.** Koukounis, C.; Schechter, R.S.; Wade, W.H. (University of Texas). *SPEJ, Society of Petroleum Engineers Journal;* 23: No. 2, 301-310(Apr 1983).

The efficiency of oil recovery by waterflooding can be greatly improved by the addition of judiciously selected surfactants. Under certain conditions, when surfactant solutions are mixed with oil, microemulsions are formed that may be in equilibrium with an excess oil (Type I), an excess aqueous phase (Type II), or both (Type III). The partitioning of the surfactant between those coexisting equilibrium phases is important to consider in the design of microemulsion processes for oil recovery. This is particularly true because different phases generally move at differing velocities within the pore spaces of an oil reservoir and therefore fractionation will occur in successive stages along the flow path. This leads to chromatographic separation of the surfactant molecules. The problem is complicated because all surfactant systems are blends of molecules, and chromatographic separation will result in a change in the optimal salinity of the surfactant system. Thus, a system that is initially optimized will not remain optimized during the course of the flood. To examine the question of selective surfactant partitioning, we varied the composition of oil/water/surfactant equilibrated systems so that they would pass through the optimal formulation region. The partitioning of anionic surfactants into the oil in Type I and Type III phase systems was small. Furthermore, binary and ternary mixtures of these surfactants were found to copartition; that is, little if any fractionation was detectable. Their collective behavior was intermediate between those of the pure components. Nonionic surfactants, unlike anionics, partition substantially into the oil phase in Type I and Type III phase systems. This was found to be an intrinsic property of the surfactant structure and not unique to those nonionic surfactant systems that are polydisperse. Selective fractionation also was found for polydisperse nonionic surfactants.

153 **Equilibrium phase compositions of CO_2/crude oil mixtures--part 2: Comparison of continuous multiple-contact and slim-tube displacement tests.** Orr, F.M. Jr.; Lien, C.L.; Silva, M.K. (New Mexico Petroleum Recovery Research Center). *SPEJ, Society of Petroleum Engineers Journal;* 23: No. 2, 281-290(Apr 1983).

Results of phase composition and density measurements for CO_2/crude-oil mixtures at 32°C and four pressures are reported for a system in which liquid/liquid and liquid/liquid/vapor phase separations occur. The experiments demonstrate that a CO_2-rich liquid phase can contain as much as 30 wt% hydrocarbons and show that a CO_2-rich vapor phase at the same conditions extracts hydrocarbons less efficiently. Pseudoternary phase diagrams are presented that summarize the results of the detailed phase composition measurements. Results of slim-tube displacements at the same four pressures are also given. They indicate that displacement is efficient when the pressure is high enough that a liquid CO_2-rich phase appears. Predictions of the performance of the slim-tube displacements based entirely on the experimental measurements of phase compositions and densities are obtained using a simple one-dimensional (1D) simulator. The simulation results clarify the roles of phase behavior and volume change on mixing in the slim-tube tests. Finally, the advantages and limitations of the slim-tube and continuous multiple-contact (CMC) tests are compared. The authors conclude that the CMC experiment yields more information useful for prediction of the performance of a CO_2 flood.

154 **A thermodynamic model for low interfacial tensions in alkaline flooding.** Sharma, M.M.; Yen, T.F. (University of Southern California). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* 23: No. 1, 125-134(Feb 1983).

Many experimental studies have been undertaken to measure interfacial tensions (IFT's) as a function of pH, salinity, temperature, and divalent ion concentrations. This behavior varies from one crude oil to another and is critical in determining its suitability as a candidate for caustic flooding. A model based on a thermodynamic analysis of crude oil/caustic interfaces has been developed that predicts the IFT behavior of such systems. The model accounts for IFT variations with changes in pH, salinity, and temperature by using parameters that must be estimated from a preliminary experimental study. The model predictions compare well with earlier reported experimental results. It is shown that the application of such a model to empirical correlations for residual oil saturations and fractional flow curves enables us to predict the changes in the fractional flow and relative permeability curves for an alkaline flood with self-sharpening fronts if the injection pH and salinity are specified.

0204 Processing

155 **(DOE/BC/10658—6) Used lubricating oil re-refining demonstration plant data acquisition: Lakewood Oil Service. Governmental permitting process report.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Nov 1983. Contract AC19-81BC10658. 77p. NTIS, PC A05/MF A01. Order Number DE84001156.

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Lakewood Oil Service has historically processed used oil for burner fuel. Three years ago Lakewood decided to build a re-refinery to process five million gallons of used oil to a quality lubricant base stock. This report is the first in a series of three topical reports and a final summary report. This report documents the environmental permitting process encountered by Lakewood in Southern California. Subsequent topical reports will cover construction and startup, and the economic and technical aspects of steady-state plant operation. After reviewing the environmental permitting process, some recommendations to help expedite the environmental permitting process for future applicants are suggested: (1) determine if the state has an office or agency to help with permitting generally; (2) request application information as early as possible; (3) request application package not just forms; (4) ask agencies how long it takes to evaluate an application and if pre-application meetings with technical staff are available; (5) review application forms for required information that a. is on hand, b. must be obtained through an outside source, c. is required on other applications, d. may need clarification; (6) review application forms for required prerequisite approvals; (7) be sure application forms are as complete as possible before submittal. A recommended order for environmental permit application submittal for an oil re-refinery in California, based on the above recommendations, is shown as Flow Chart X.

156 **(DOE/EIA—0425, pp 23-37) Trends in refinery capacity and utilization (results of 1983 EIA refinery survey).** Campbell, E.E. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The 1982 EIA Refinery Survey reports that after years of growth which reached a peak in 1981, the number of operable refineries is now smaller than any time since data collection began 65 years ago. The economic background for changes in the refining industry are presented and the type was of changes made are categorized. It is anticipated that future refiners can either pay premiuum prices to continue to receive crude oil of high quality or invest in downstream capacity which can process crude oils in a broader range. Thus far, the industry has chosen to reduce the number of small units, reduce the number of companies, concentrate refining capacity closer to crude-oil supplies, and increase the ability to process heavier, higher-sulfur crude oils according to the survey. 4 figures, 6 tables.

157 **(DOE/PC/30204—T1) Surface studies of WO_3/Al_2O_3 and Ni/W/Al_2O_3 catalysts.** (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 1983. Contract AC22-80PC30204. 28p. NTIS, PC A03/MF A01. Order Number DE84000930.

In the present study x-ray photoelectron spectroscopy, laser Raman spectroscopy and ion scattering spectroscopy were used to investigate the surface structure of supported tungsten catalysts for hydrodesulfurization of sulfur containing petroleum fractions. The properties of WO_3/Al_2O_3 catalysts were examined as a function of

metal loading, calcination temperature and reduction time. The addition of nickel was also studied to determine its effect on the tungsten species present on the catalyst surface. This study has provided a comprehensive picture of the nature of the tungsten species present in WO_3/Al_2O_3 and $Ni/W/Al_2O_3$ catalysts. It has been shown that WO_3/Al_2O_3 and MoO_3/Al_2O_3 catalysts are very similar structurally. Preliminary results for $Ni/W/Al_2O_3$ catalysts have shown that the promoting action of Ni is different than that of Co in $Co/Mo/Al_2O_3$ catalysts. 31 references, 6 figures, 3 tables.

0205 Products And By-products

REFER ALSO TO CITATION(S) 155, 169, 939

158 (DOE/EIA—0425, pp 69-95) **Minimum operating inventories for gasoline, distillate fuel oil, and residual fuel oil.** Farmer, R.D. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

This report presents an analysis of current stock levels for the major petroleum products in relationship to their respective minimum operating inventories (MOI). The main objectives are to assess how MOI's for these products have changed in recent years and to evaluate the adequacy of current stock levels with respect to these revised MOI's. The analysis is based on a two-part approach that identifies and separately evaluates the economic incentives for holding product as a minimum operating inventory and to satisfy the seasonal excess of product demand over refining capabilities. The conclusion evaluates the adequacy of anticipated product stock levels for 1983 to support consumer requirements. A Technical Appendix is included. 4 references, 5 figures, 3 tables.

159 (DOE/EIA—0425, pp 305-316) **Liquefied petroleum gas reporting.** Oleson, G.L. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The Office of Oil and Gas, Petroleum Supply Division, as recently conducted a review of its system for collecting data on the supply and disposition of liquefied petroleum gases (LPG). This review was undertaken primarily in response to the concerns expressed by industry and government data analysts regarding the accuracy of published LPG statistics. In this paper LPG is described in terms of its sources and uses, and then a description of EIA's method of collecting information on LPG production and disposition is presented. Finally, the key findings of the review of the LPG reporting system are summarized and changes are suggested to improve the LPG data quality and usability. 6 figures.

0206 Health And Safety

REFER ALSO TO CITATION(S) 123

160 (DOE/SSDC—76-45/16) **Systems safety analysis manual for Strategic Petroleum Reserve office drilling and completion operations.** Nertney, R.J.; Butcher, H.B. (EG and G Idaho, Inc., Idaho Falls (USA); REECo, Las Vegas, NV (USA)). Apr 1979. Contract AC07-76ID01570. 55p. (SSDC—16). NTIS, PC A04/MF A01. Order Number DE84002511.

This manual provides guidelines for use of the Department of Energy's Management Oversight and Risk Tree (MORT) system to assess Strategic Petroleum Reserve (SPR) drilling, completion and workover programs.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 158, 714

161 (DOE/EI/19617—T1) **Residential heating oil price monitoring projects, Minnesota: Winter 1982-83. Final report.** Krastins, A.; Krastins, I. (Minnesota Dept. of Energy, Planning and Development, St. Paul (USA)). May 1983. Contract FG01-82EI19617. 43p. NTIS, PC A03 . Order Number DE84000180.

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As it has done during previous heating seasons, the Energy Division of the Department of Energy, Planning and Development (DEPD), monitored No. 2 fuel oil prices for the 1982-83 heating season. The DEPD collected monthly No. 2 heating oil retail and rack prices from a sample of distributors to determine state average prices for the 1982-83 heating season. Inventory levels were also monitored during this period. Survey results were then sent to the EIA within the first week of each month. DEPD drew its own retail dealer samples from a current list of petroleum distributors to obtain sufficient respondents for each of the market stratum specified by DOE. Economic recession, price-induced conservation, and fewer heating degree days than normal, lead to lower, yet adequate primary inventory levels and supplies of No. 2 fuel oil to residential customers. Retail prices decreased 16%, rack prices 24% from October to April due to lower crude oil prices and reduced end-user demands. Monthly survey results were used to update historic prices, to allocate federal fuel assistance grants, and were shared with other state departments, the state legislature and Office of the Governor, petroleum suppliers, the New York Energy Office, the media and the general public. The monthly surveys were important sources of timely information at the local level and a vehicle for maintaining contacts with suppliers in the state.

162 (DOE/EIA—0109(83/10)) **Petroleum supply monthly.** (USDOE Energy Information Administration, Washington, DC). Oct 1983. 81p. NTIS, PC A05/MF A01 - GPO. Order Number DE84001689.

Statistics are presented for August 1983. (PSB)

163 (DOE/EIA—0380(83/09)) **Petroleum marketing monthly.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Sep 1983. 86p. NTIS, PC A05/MF A01 - GPO. Order Number DE84001407.

Monthly summaries of petroleum product statistics for the United States, Petroleum Administration for Defense (PAD) Districts, and individual states. Three types of petroleum product statistics are included: prices, volumes, and percentages of sales. The publication highlights statistics in a summary, and covers each of the three subjects in detail in separate sections. The first tables in each section provide national-level statistics on sales of the various products to end-users and for resale. The following tables provide finer geographic and type of seller detail and are grouped by product, beginning with motor gasoline and ending with either residual fuel oil or propane. To aid the reader in determining market changes, the majority of the tables show data for the report month and previous month.

164 (DOE/EIA—0425) **Proceedings of the Energy Information Administration symposium on petroleum supply information.** Kendell, J.M. (ed.). (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Sep 1983. 312p. (CONF-8308138—). NTIS, PC A14/MF A01. Order Number DE84001387.

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

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The symposium was organized to: (1) present information on the sources, availability, processing systems, scope, and quality of petroleum-supply information; (2) present information on current petroleum supply and petroleum-supply outlook; (3) preview experimental work on inventory analysis; and (4) provide a forum for users of petroleum-supply information to discuss and comment on

EIA procedures and activities. The symposium brought together more than 400 representatives of industry, trade groups, energy publishers, Government, and other interested parties. A separate abstract was prepared for each of the 15 individual presentations.

165 (DOE/EIA—0425, pp 5-22) **Petroleum Supply Division activities: present and future.** Lalley, F.E. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The two-year old Petroleum Supply Division of the Energy Information Administration is involved in generating and reviewing petroleum supply information. It focuses its attention on the key components of supply, on the major fuels, and on facilities to be able to identify and measure significant factors that influence changes in petroleum supply. It publishes its findings in three in-house periodicals, in lead articles in the Petroleum Supply Monthly, in summaries in the Petroleum Supply Annual, and in special analytical reports. The recent changes the Division has made to streamline and improve its work are discussed. 10 figures.

166 (DOE/EIA—0425, pp 39-68) **World oil price and inventory cycles.** Moore, J.L. (Applied Management Sciences, Silver Spring, MD). Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

Preliminary experimental results of an analysis by the EIA illustrate how econcomic factors influence primary petroleum inventory fluctuations. After outlining the US petroleum inventory movements of the tumultuous seventies and developing the economic relations that influence optimal stock levels, it is concluded that the inventory fluctuations associated with events of the last decade are unlikely with the current economic recovery. An appendix includes the econometric results. 10 references, 9 figures, 6 tables.

167 (DOE/EIA—0425, pp 97-109) **EIA petroleum supply surveys: an overview.** O'Neill, R.W. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

An overview of the petroleum-supply survey systems operated by the Energy Information Administration (EIA) is presented. It explains why the EIA measures petroleum activity at the points it does, describes the kinds of information it collects and from whom, and discusses the EIA's continuing efforts to maintain timely, accurate statistics describing the industry. Also addressed is the importance of having the participation of people knowledgeable of the petroleum industry. 5 figures.

168 (DOE/EIA—0425, pp 111-133) **System improvements: the Integrated Petroleum Supply Data Base.** Molloy, B. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The progress in the area of data systems made by the Petroleum Supply Division is presented by comparing the old systems with the new systems, focusing on forms, methodology, processing systems, and access. The organization set four major goals to overcome the problems inherent in the old data systems: consistency; improved data quality; improved processing systems; and easily accessible data. The Improved Processing Systems (IPS) data is managed by the ADABAS data base management system which is comprised of two main sections, the aggregated data and the respondent level data. 13 figures.

169 (DOE/EIA—0425, pp 147-163) **Current petroleum situation: expectations for Fall and Winter 1983-1984.** Linden, A.H. Jr. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

Expectations for petroleum demand, supply, and prices for the 1983-1984 heating season are presented. Distillate fuel oil is emphasized, but motor gasoline, residual fuel oil, and petroleum markets in general are also briefly addressed. The supply/demand situation and price changes of 1982 are attributed to Middle Eastern politics, conservation, the US economy, and mild winter weather. It is anticipated that total petroleum demand during the winter of 1983-1984 to average 15.86 million barrels per day, about 5% higher than the 15.12 million barrels per day during last winter. The higher rates are based on the continuing US economy recovery, stable world crude oil prices, and normal weather patterns. Motor gasoline demand, however, is expected to remain stable or fall slightly due to the improved efficiency of current automobiles. 4 references, 6 figures.

170 (DOE/EIA—0425, pp 165-173) **Outlook for world crude oil prices.** Kilgore, W.C. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The Energy Information Administration's projections on the probable price of world oil are made quarterly and annually and published in their Short-Term Energy Outlook and Annual Energy Outlook. The EIA base-case outlook is that world oil prices will stabilize at roughly their current level through the middle of this decade, but the world oil market is also anticipated to tighten due to the improving world economy and the rising prices of competitive fuels. OPEC's unused production capacity is a major factor underlying this projection. 3 figures.

171 (DOE/EIA—0425, pp 205-245) **Intermediate-term petroleum projections.** Pearson, J.D. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

This paper summarizes the Energy Information Administration projections for petroleum supply and consumption for the years 1985-1990. This projection is taken from the Annual Energy Outlook (AEO) and its predecessor organizations. The AEO studies the US energy market in general and the relative demands for competing fuels to supply the energy. This paper summarizes the key assumptions and then presents the essential trends in each of the energy-consuming sectors and the role of oil in each. 18 figures, 2 tables.

172 (DOE/EIA—0425, pp 247-264) **Advances in quality control in PSD data.** Thibodeau, L.A. (Applied Management Sciences, Silver Spring, MD). Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

This paper presents an overview of quality-control activities within the Petroleum Supply Division during the past two and one-half years. Based on these improvements, numerous quality-control improvements have been implemented within the last nine months. Probably the most significant advance has been the automation of the survey system into the Integrated Petroleum Supply Data Base. This integration process, which is continuing, has made many methodological enhancements to the system possible. In each instance, the enhancements resulted from a series of steps that included evaluation of current methods, development of improved methods if warranted, and finally, implementation. 11 references, 1 figure, 4 tables.

173 (DOE/EIA—0425, pp 265-284) **Statistical design of the Weekly Petroleum Status Report.** Burns, E.M.; Ahmed, Y. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The <Weekly Petroleum Status Report> (WPSR) is developed to provide information on petroleum stocks, imports, and refinery operations in a more-timely manner than the Energy Information Administration (EIA) monthly petroleum publications. The main source of this information is a set of six weekly surveys, each designed to capture information on different aspects of the petroleum-supply situation. This paper addresses two main questions about the weekly survey design: (1) where does EIA get its weekly

data; and (2) what does EIA do with its data once it gets it. 11 references, 1 table.

174 (DOE/EIA—0425, pp 285-303) **Timeliness and accuracy of selected petroleum-supply data series.** Kirkendall, N.J. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The Petroleum Supply Division of the Office of Oil and Gas in the Energy Information Administration (EIA) collects and publishes statistics concerning the supply and movement of petroleum in the United States. EIA's Petroleum Supply Reporting System (PSRS) measures supply and throughput at various points in the petroleum-supply flow, from the production of crude oil to the distribution of petroleum products. This paper discusses the accuracy of the petroleum-supply data, updating the assessment that appeared in the April 1982 Petroleum Supply Monthly and presenting new material on the accuracy of weekly data. 7 figures.

175 (DOE/PE—0029/2) **Energy projections to the year 2010: a technical report in support of the National Energy Policy Plan.** (USDOE Office of Policy, Planning and Analysis, Washington, DC). Oct 1983. 185p. NTIS, PC A09/MF A01. Order Number DE84001191.

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Underlying these energy projections are assumptions and results about key variables - world oil prices, economic growth, energy consumption, and production potential - which are described in this document. The projections are based on information available through June 1983. Projecting US energy supply, demand, and prices through the year 2010 is by nature a highly uncertain process. These projections try to account for uncertainty by providing a variety of scenarios that account for alternative future conditions. Results indicate that although the outlook for future world oil prices is highly uncertain, most analysts now agree that, barring a significant oil supply disruption, world oil prices will most likely fall in real terms until the mid 1980's. From 1985 to 1990, prices will most likely increase in real terms. Beyond 1990, the outlook becomes increasingly uncertain. The oil price increases of 1973 to 1974 and 1979 to 1980 have set into motion powerful energy conservation forces that are likely to continue causing energy (especially oil) to be used more efficiently. Consequently, we need to pay continuing attention to analyzing and evaluating energy conservation trends in world economies. The recent decline in world oil prices has added a new dimension to the uncertainty about future market conditions. Prior to 1983, OPEC had never officially reduced the posted price of oil, but rather used the influence of inflation to allow prices to fall gradually in real terms during periods of excess world supply. Now, investment planners must not only be concerned about the potential for oil price shocks, which can send the oil price very high, but also about future price breaks which could send the price very low. Under all but extreme assumptions, both the US and the rest of the world will remain dependent on liquid fuels, including oil supplies from OPEC, throughout at least the next 20 years. 73 references.

176 (NP—4900214) **Oil and gas developments in Pennsylvania in 1981. Progress report 195.** Harper, J.A. (comp.). (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1982. 121p. State Book Store, P.O. Box 1365, Harrisburg, PA 17125.

Oil production totaled 3,729,214 barrels in 1981, a 27 percent increase over 1980 production. Oil reserves increased 1 percent from 50,559,000 barrels in 1980 to 50,946,000 barrels in 1981. Gas production increased 26 percent from 97,439 million cubic feet in 1980 to 122,454 million cubic feet in 1981. Gas reserves, including stored recoverable gas, increased 7 percent from 2,316,119 million cubic feet in 1980 to 2,481,168 million cubic feet in 1981. Stored recoverable gas also increased 7 percent, to 596,518 million cubic feet. The price for all crude oil and oil products produced in the United States was deregulated by the President early in 1981. The price of Penn Grade Crude oil was $38.00 per barrel at the beginning of 1981, but dropped off to $35.00 per barrel on June 17. The price remained stable for the remainder of the year. Gas prices were subject to Natural Gas Policy Act price ceilings. The wellhead price of one thousand cubic feet of natural gas ranged from a low of $0.24 under old contracts to $5.10 for high-cost gas produced from tight formations (the Lower Silurian Medina Group). The total number of wells reported drilled in 1981 was 3554, an increase of 76 percent or 1534 wells over 1980. Exploratory drilling in 1981 increased 207 percent (273 wells) over 1980, and the success rate for these wells was 94 percent. Seismic exploration activity increased 21 percent, from 45.25 crew-months in 1980 to 54.75 crew-months in 1981. 32 figures.

177 (P—300-83-005) **California historical petroleum prices.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Mar 1983. 50p. California Energy Commission's Publication Unit, 1516 9th Street, Sacramento, CA 95814.

A series of tables containing historical petroleum fuel prices and electric utility fuel oil costs for California is presented. Petroleum prices and costs are reported in current nominal dollars and in constant 1980 real dollars. The California Consumer Price Index was used for converting nominal prices into real prices. The petroleum commodities for which prices are presented in this report are crude oil, gasoline (regular, premium, unleaded), No. 2 distillate (diesel), No. 6 residual fuel oil (utility costs), No. 2 fuel oil (utility costs), LPG (propane), marine diesel, marine gasoil and No. 6 (Bunker C). The figures in this document were compiled from various government and trade industry publications.

0208 Waste Management

178 (DOE/BC/10375—6) **Fate of hazardous and nonhazardous wastes in used-oil disposal and recycling. Final report.** Surprenant, N.F.; Battye, W.H.; Fennelly, P.F. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Oct 1983. Contract AC19-81BC10375. 246p. NTIS, PC A11/MF A01. Order Number DE84002555.

The primary objective of this program was to identify the hazardous and nonhazardous compounds that might reasonably be found in used oil and to establish their fate under a variety of disposal and recycling scenarios. Those considered were sewer disposal, road oiling, combustion as a fuel, reprocessing by physical methods to produce a specification fuel, and various re-refining processes. A secondary objective was to assess the potential environmental impact of the contaminants in the waste and product streams associated with each scenario. The hazardous and nonhazardous compounds of major interest in waste oil were identified by literature review, interviews with participants in waste oil activities, and by laboratory analysis of 24 samples of waste oils obtained from recyclers and users. The contaminants were prioritized according to their concentrations in the oil and their health impacts, as determined by threshold limit values, drinking water standards, or other measures of multimedia health impacts. The prioritized listing formed the basis for the preparation of the COMPOSITE oil used in the experimental simulation studies of the waste oil disposal and recycling scenarios. The experimental simulation studies were designed to establish the fate, through material balance if possible, of specific contaminants under conditions that were representative of those normally encountered in each situation. In addition to the laboratory simulation studies, computer simulations were conducted to assess the physical transport of specific compounds during typical re-refining operations such as dehydration, light end removal, and vacuum distillation. 126 references, 15 figures, 93 tables.

179 (DOE/CS/40338—3) **North Carolina used-motor-oil re-refining program: economics and logistics; and operating results. Topical report 3.** Canada, J.R. (North Carolina State Government, Raleigh (USA)). Jul 1983. Contract FG01-80CS40338. 20p. NTIS, PC A02/MF A01. Order Number DE84001448.

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This is the third in a planned series of topical reports on a program to develop and demonstrate a State-operated re-refining system for used engine oil. The North Carolina Oil Re-Refining Facility, using a 2,000,000 gallon input per year PROP plant, was in-

stalled in late 1980. During the first year of startup operation ending December 31, 1981, approximately 137,000 gallons were produced. Report 2 of this series reflects on the startup experience and financial results for the first year of operation (1981) as well as projected expectations at that time. This report concentrates on operating and financial results for 1982 and the first five months of 1983. During the 17 months ending May 1983 only about 270,000 gallons were produced and sold. Based on normal annual accounting the loss for that period was $685,060 and the cashflow loss was $480,679. Even after substantial upgrading modifications were done in 1982-83, the plant still has major throughput problems, the greatest of which is the required quality and quantity of used oil feedstock. The report describes financial results, cost-variance analyses, production impediments encountered, and also projects future operating volumes necessary for the facility to cover costs.

180 **(PB—83-241273) Land treatment field studies. Volume 1. Petroleum wastewater pond bottoms. Final report Sep 77-Feb 81.** Berkowitz, J.B.; Bysshe, S.E.; Goodwin, B.E.; Harris, J.C.; Land, D.B. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1983. 53p. NTIS, PC A04/MF A01.

This report presents the results of field measurements and observations on a land treatment site for management of waste bottoms from a petroleum wastewater treatment pond. The waste is typically 13% solids, 25% oil, and 62% water as spread. The site was sampled twice, and observations were made on the type and amount of waste handled, site characteristics, and management procedures for waste application and monitoring. Organic and inorganic analyses were conducted on the waste and soil/waste mixture; inorganic analyses were performed on plant samples.

181 **(PB—83-241281) Land treatment field studies. Volume 2. Oily waste from a petroleum refinery. Final report Sep 77-Feb 81.** Berkowitz, J.B.; Bysshe, S.E.; Goodwin, B.E.; Harris, J.C.; Land, D.B. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1983. 53p. NTIS, PC A04/MF A01.

This report presents the results of field measurements and observations of a land treatment site operated for disposal of petroleum refinery waste sludges. The waste, principally API separator bottoms, was land treated in an area long used for waste disposal. The site was sampled once, and observations were made on the type and amount of waste handled, site characteristics, and management procedures for waste application and monitoring. Organic and inorganic analyses were conducted on the waste and soil/waste mixture; inorganic analysis was performed on plant samples.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 155, 178, 180, 181, 1379, 1389, 1391, 1393, 1394, 1395, 1396

182 (CONF-821199—, pp 6-14) **Identifying reservoirs susceptible to subsidence due to fluid withdrawal.** Dusseault, M.B. (Univ. of Waterloo, Ontario). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The major criteria for identification of subsidence-prone reservoirs have been discussed. They remain semi-quantitative, but provide a means of identifying susceptible locations. The most susceptible reservoirs are: (1) Geologically young, shallow, and uncemented; (2) Located in sedimentary basins with a history of monotonic deposition without uplift; (3) Lacking in diagenetic fabric; (4) Argillaceous in mineralogy; (5) Characterized by high in situ porosities (> 0.30); (6) Characterized by low sonic velocities ($< \sim 2.2$ km/sec); and (7) Thick and laterally extensive. Refining this conceptual model requires an integration of existing case histories, reexamination of sampling and laboratory procedures, and systematic preplanned monitoring of future subsidence sites. 20 references, 10 figures.

183 (CONF-821199—, pp 109-120) **Aspects of compaction/subsidence in the Bolivar coast heavy oil fields, highlighted by performance data of the M-6 project area.** Schenk, L.; Puig, F. (MARAVEN, Caracas, Venezuela). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

This paper deals with the compaction-subsidence performance of the four Bolivar Coast heavy oil reservoirs located near Lake Maracaibo in the State of Zulia, Venezuela. In the 1920's this area began to show subsidence. In addition to the construction of adequate dykes, this subsidence prompted the installation of a network of bench marks, which are surveyed bi-annually. It soon became apparent that the areas with the greatest subsidence coincided with the most depleted parts of the fields. This established a cause-effect chain of oil-production, pressure-decline, formation-compaction, and surface-subsidence which has since been a fertile field for scientific investigation. The study concentrates on a description of the observed subsidence/compaction behavior in terms of compressibilities measured on core samples in the laboratory and the pressure history of the reservoir in the area. The approach followed in this is supported by a reservoir engineering analysis of the area. 5 references, 12 figures, 5 tables.

184 (CONF-821199—, pp 121-132) **Subsidence monitoring methods and bench mark elevation response to water injection, Wilmington oil field, Long Beach, California.** Colazas, X.C.; Olson, L.J. (City of Long Beach, CA). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The authors discuss the history of subsidence in the Wilmington oilfield of California which is due to pressure depletion in the oil reservoirs caused by fluid withdrawals. The extent of subsidence is illustrated with maps, graphs, and tables. They briefly discuss some of the related problems, such as oil well damage and surface land problems. Subsidence in the Wilmington Field reached a rate of nearly two feet (0.6 m) per year in 1952 with a total sinking of over 29 feet (8.8 m) at the center of the bowl. The land surface has been stabilized with a massive water injection program that has resulted in a rebound in some areas. 9 references, 12 figures.

185 **(EGG—10282-2020) Kit fox flea relationships on the Naval Petroleum Reserves, Kern County, California.** Egoscue, H.J. (EG and G, Inc., Goleta, CA (USA)). 1977. Contract AC08-83NV10282. 11p. NTIS, PC A02/MF A01. Order Number DE84002668.

Of 310 collections totaling 4490 individuals of seven species of fleas from kit foxes in the Elk Hills area, southern San Joaquin Valley, California, 93.16% were the introduced Echidnophaga gallinacea; 5.1% were Cediopsylla inaequalis; 1.25% were Pulex irritans; 0.2% were Thrassis augustsoni; 0.16% were Odontopsylla dentatus; 0.07% were Meringis californicus; and 0.07% were Hoplopsyllus anomalus. Circumstantial evidence based on the flea data suggests that lagomorphs make up the bulk of the prey of Vulpes macrotis mutica, and that the desert cottontail may be more important than the black-tailed hare in the diet of this fox. 17 references

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 142

0230 Properties

REFER ALSO TO CITATION(S) 189

186 **(DOE/BC/10749—2) Lubricating-oil basestock data and analysis: based on the ASTM-NBS basestock consistency study.** Becker, D.A.; Hsu, S.M.; Weeks, S. (National Bureau of Standards, Washington, DC (USA)). Oct 1983. Contract AI19-82BC10749. 482p. NTIS, PC A21/MF A01. Order Number DE84002002.

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In this 13-month study, four virgin oil and six re-refined oil companies submitted monthly production samples to National Bureau of Standards (NBS). There, the samples were subdivided, coded, and sent to 14 participating laboratories for analysis of the physical and chemical properties as well as for evaluation in various bench tests. An eleventh control sample was sent monthly for reference. Various re-refining processes included in the study are: acid/clay; clay treatment; short path distillation; pretreat/vacuum distillation/clay finish; pretreat/hydrogenation. The processes for the virgin base oils are mainly solvent extraction/distillation with and without the hydro-finishing step. In this report the data are grouped into six main categories: (1) theology; (2) physical properties; (3) chemical properties; (4) hydrocarbon type analysis; (5) general performance tests; and (6) oxidation and wear bench tests. Within each category, test results are arranged according to the similarity of the tests or test properties.

187 **(IFP—30-953) Separation and characterization of acids in crude oils.** Behar, F. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Strasbourg-1 Univ., 67 (France)). 1982. 183p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84750128.

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The saponification of five crude oils by alcoholic potash has led to the isolation of an acid fraction containing both mono-and polyfunctional compounds. The acids obtained were reduced to hydrocarbons by Li Al H_4 then separated by liquid chromatography into saturated hydrocarbon, aromatic hydrocarbon and polar compound fractions. At the same time the oil hydrcarbons were characterised in the search for correlations between acids and hydrocarbons. Analyses by liquid chromatography and mass spectrometry show, for acids and hydrocarbons: - an identical saturated/aromatic ratio, - the same distribution, in saturated structures, between paraffins and naphthenes, - little or no correlation for aromatic hydrocarbons. Detailed analyses by gas chromatography-mass spectrometry lead to three conclusions: - the quantities of n alcanes in the hydrocarbons are on a par with those of n acids in the acid fraction, - the abundance of tricyclic structures increases with the biodegradation state of the oil, at the expense of pentacyclic structures. This is more pronounced in acids than in hydrocarbons, - for saturated pentacyclic compounds the same hopanic prints were found in the acids and hydrocarbons but with a difference of one carbon atom. This confirms the possible genesis of hopanic hydrocarbons by decarboxylation of the corresponding acids.

0240 Storage

REFER ALSO TO CITATION(S) 166

188 **(SAND—83-1761) Nitrogen leak test of Strategic Petroleum Reserve Cavern Bayou Choctaw 2.** Goin, K.L. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01. Order Number DE84002755.

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A nitrogen leak test was made of the Strategic Petroleum Reserve Bayou Choctaw Cavern 2. Results of the test are inadequate for estimating the cavern leak rate with a high level of confidence. The interpretation of test results believed to be the most reasonable indicates an average nitrogen loss rate of 300 bbls/yr with an 84-percent probability the loss rate does not exceed 1950 bbls/yr. With maximum oil loss rates estimated at one third of nitrogen volume loss rates, corresponding oil loss rates are 100 and 650 bbls/yr. 3 references, 8 figures.

0250 Combustion

REFER ALSO TO CITATION(S) 118, 1180

189 **(DOE/BETC/PPS—83/4) Heating oils, 1983.** Shelton, E.M. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Aug 1983. 37p. NTIS, PC A03/MF A01. Order Number DE84001699.

Properties of 195 heating oils marketed in the United States were submitted for study and compilation under agreement between the Bartlesville Energy Technology Center (BETC) and the American Petroleum Institute (API). The fuels were manufactured by 25 petroleum refining companies in 83 domestic refineries. The data are tabulated according to six grades of fuel and subdivided into five geographic regions in which the fuels are marketed. The six grades of fuels are defined by the American Society for Testing and Materials (ASTM) Specification D396. The five regions containing a total of 16 marketing districts are shown on a map in the report. Trend charts are included showing average properties of the six grades of fuel for the past several years. Summaries of the results of the tests by grade and by region for 1983 are compared with data for 1982. 7 figures, 12 tables.

190 **Effects of diluents on the flame structure and soot concentration of synthetic fuel sprays.** Gollahalli, S.R.; Beach, V. (Combustion and Propulsion Laboratory School of Aerospace, Mechanical and Nuclear Engineering, The University of Oklahoma, Norman, OK 73019). *American Society of Mechanical Engineers, [Paper];* **83-PET-2**: 7(1983).

Experimental results on the effects of inert diluents on the flame structure and soot concentration of burning airblast atomized liquid sprays are presented. A petroleum-derived liquid (No. 2 oil), a shale-derived liquid (DFM), and two samples of coal-derived liquids (SRC-II) were used as fuels. Air, carbon dioxide, and nitrogen were used as the atomizing gas. The results indicate the use of diluents in the atomizing stream, although decreased soot formation rate, does not affect its liberation from the flame significantly.

191 **The navy mobility fuels data center.** Gubiotti, R.A.; Hazard, H.R.; Hershner, C. (Battelle Columbus Laboratories, Columbus, Ohio). *American Society of Mechanical Engineers, [Paper];* **82-IPGC-GT-2Z**: 5(1982). (CONF-821018—).

From IEEE/ASME/ASCE joint power generation conference; Denver, CO, USA (17 Oct 1982).

The Navy Mobility Fuels Reference File is a computer searchable library of technical literature dealing with properties of synthetic and petroleum fuels and their effects on gas turbines, diesel engines, steam boilers, and fuel systems. It contains over 1800 technical reports, papers, and articles relating some aspect of fuel composition to some aspect of engine performance or operation. The system is available to qualified users through remote terminal devices compatible with Battelle's CDC computer.

03 NATURAL GAS

192 **(DOE/METC—83-65-Rev.) Interdisciplinary Gas Hydrate Literature Bibliography. Revision.** Malone, R.D.; Gregoire, C.E. (eds.). (USDOE Morgantown Energy Technology Center, WV). Sep 1983. 59p. NTIS, PC A04/MF A01. Order Number DE84001900.

Approximately one-half of the entries are concerned with the general geology of high-hydrate potential regions, permafrost characterization, and the chemistry of clathrate compounds. Natural gas hydrate-specific literature is relatively rare, although more articles appear each month. Reports of modeling work, laboratory investigations, field experiences, and incidences of natural core recovery have increased steadily as interest in natural gas hydrates grows. These entries in this bibliography include current journal articles, books, reports, proceedings, conference or symposium papers, and foreign publications. Some of these publications date back to 1823. For the researcher or interested individual, this bibliography is a resource that includes information on general and specific hydrate characterization, history and state-of-the-art exploration, and gas production activities.

0301 Reserves

REFER ALSO TO CITATION(S) 176, 197

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 136

193 **(N—8321426) Correlation of LANDSAT lineaments with Devonian gas fields in Lawrence County, Ohio.** Johnson, G.O. (Ohio Dept. of Energy, Columbus (USA)). Jan 1981. 5p. NTIS, PC A11/MF A01.

In an effort to locate sources of natural gas in Ohio, the fractures and lineaments in Black Devonian shale were measured by: (1) field mapping of joints, swarms, and fractures (2) stereophotointerpretation of geomorphic lineaments with precise photoquads and (3) by interpreting the linear features on LANDSAT images. All results were compiled and graphically represented on 1:250,000 scale maps. The geologic setting of Lawrence County was defined and a field fracture map was generated and plotted as rose patterns at the exposure site. All maps were compared, contrasted, and correlated by superimposing each over the other as a transparency. The LANDSAT lineaments had significant correlation with the limits of oil and gas producing fields. These limits included termination of field production as well as extensions to other fields. The lineaments represent real rock fractures with zones of increased permeability in the near surface bedrock.

0303 Drilling, Production, And Processing

194 **(DOE/MC/21490—1441) General-purpose gas simulator for single- or multi-well studies GAS3D2, Version 1.00.** Sawyer, W.K. (Mathematical and Computer Services, Inc., Morgantown, WV (USA)). [nd]. Contract AP21-82MC21490. 140p. NTIS, PC A07/MF A01. Order Number DE84000310.

GAS3D2 is closely related to the 2-dimensional naturally fractured gas reservoir simulator, SUGARMD. The code is basically the same, except for the third dimension capability in GAS3D2 and the gas desorption/naturally fractured reservoir capabilities in SUGARMD. GAS3D2 may be considered to be a second generation model to the gas simulator in the code SIMPAC. Most of the general features such as dynamic dimensions, input/output formatting, and optional solution algorithms have been retained from SIMPAC. However, both speed and efficiency are much improved due to major changes in three areas. First, gas property data is handled by a simple table look-up routine in GAS3D2, as compared to the rigorous, but time consuming, polynomial and Newton-Raphson iterative technique used in SIMPAC for gas viscosity and z-factor determination. Second, the nonlinearity introduced by the quantity P/Z on the right-hand side of the final material balance equation is rigorously handled in GAS3D2 by the iteration scheme presented by van Poolen. Convergence is nearly always obtained in three to five iterations with all coefficients updated. Thus, by specifying a convergence tolerance of 1 psi, one is assured of complete coefficient updating. This permits use of much larger time-steps and also improves material balance errors. The third major improvement in GAS3D2 is the use of all implicit source terms, as mentioned earlier. This also permits larger time-steps and completely avoids oscillation problems that frequently are associated with explicit source terms. In addition to the major improvements mentioned above, three new routines have been added for bottom hole to surface pressure calculations. This is a major step in providing the capability to simulate a complete gas field operation. In fact, together with a surface pipeline model, GAS3D2 could be used for an operational study of a large gas or storage field. 9 references.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 176, 651

195 **(DOE/EIA—0167(82)) Gas supplies of interstate natural gas pieplelne companies, 1982.** Arnold, J.; Price, R.; Pridgen, V. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Oct 1983. 120p. NTIS, PC A06/MF A01 - GPO. Order Number DE84002276.

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Information is provided on interstate pipeline companies' supply of natural gas during calendar year 1982, for use by the FERC for regulatory purposes. It also provides information to other government agencies, the natural gas industry, as well as policy makers, analysts, and consumers interested in current levels of interstate supplies of natural gas and trends over recent years.

196 **Natural gas pricing: is new legislation needed.** Sigmon, E.B. (Oak Ridge Associated Universities, TN). *Public Utilities Fortnightly;* 112: No. 6, 26-31(15 Sep 1983). Contract AC05-76OR00033.

The following article asks, and provides answers to, some timely questions about the pricing of natural gas. Why have gas prices risen at a time of oversupply. The phenomenon is attributed to the gas industry's forced legacy of price inflexibility. The ensuing question is: can the industry make the necessary adaptations without further corrective legislation. The author answers yes and explains why. 20 references, 3 tables.

0309 Artificial Stimulation

197 **(DOE/NV/10249—6) Western Gas Sands Project. Status report, July-September 1982.** (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). 1983. Contract AC08-82NV10249. 133p. NTIS, PC A07/MF A01. Order Number DE84001700.

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Progress reports are presented for this quarter under the following headings: project management; resource assessment; research and development by energy technology centers and national laboratories; field tests and demonstrations. Some of the highlights are: Terra Tek, Inc. conducted spray drying tests for Bartlesville Energy Technology Center to determine the possibility of making hollow spherical proppants using a single-fluid nozzle in a countercurrent air flow dryer; at Lawrence Livermore National Laboratory, a more automated data acquisition system was constructed for the PMMA apparatus, which is used to simulate a condition of one-dimensional fluid flow in a crack; at Los Alamos National Laboratory, work has progressed on utilizing the NMR T_1 relaxation data to determine the distribution of pore surface-to-volume ratios in core samples; work this quarter continued on the thermal neutron cross section measurements in small geological samples and on analysis of the dual spaced porosity log at Sandia National Laboratory. Stimulation and production data from wells near the MWX site are being retrieved from the project data bank for use in planning future MWX operations. The stress test display and control console hardware were completed this quarter for the DOE Well Test Facility, which is now being used for the MWX experiment. At the Multi-Well site, drilling, coring, logging, casing and cementing of MWX-2 was accomplished this quarter. 93 figures, 46 tables.

198 **(UCRL—53443) Estimating in-situ stresses and rock mass properties from geological and geophysical data: applications in the hydraulic fracturing of tight gas reservoirs.** Towse, D.F.; Heuze, F.E. (Lawrence Livermore National Lab., CA (USA)). Sep 1983. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE84002702.

Case studies are presented in which the orientation and magnitude of in-situ stresses are estimated. The estimates are based on geological mapping, geophysical logging, and materials testing. The case studies show that there has been some success in predicting stress orientation based on an analysis of geological and geophysical

data alone. The acquisition of such data should be pursued because, without other input, it is still the only way to infer the hydrofracture orientations outside of those sites where results are known from actual fracturing operations. The case studies also show the uncertainties in attempting to predict horizontal stress magnitudes. A possible approach to reducing the uncertainty of predicting the direction and magnitude of in-situ stresses is to correlate geological and geophysical data with mechanical properties derived from core and in-situ tests. Such correlations would extend the results of other tests and enable more accurate extrapolations to other levels in a given wellbore or to locations at a distance from the wellbore. 68 references, 14 figures, 5 tables.

199 **American National Standard: guidelines for establishing site-related parameters for site selection and design of an independent spent fuel storage installation (water pool type).** La Grange Park, IL; American Nuclear Society (1981). 44p. (ANSI/ANS—2.19-1981). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $25.00.

This standard presents guidelines for establishing site-related parameters for site selection and design of an independent spent fuel storage installation (ISFSI). This installation provides storage of spent light water reactor (LWR) fuel that has aged a minimum of one year after discharge from the reactor core in a water basin type structure. Such an installation may be independent of both a nuclear power station and a reprocessing facility, or located adjacent to these facilities in order to share selected support systems. Aspects considered include flooding, geology, seismology, ground water, foundation engineering, earthwork engineering, and extreme wind conditions. These guidelines identify the basic site-related parameters to be considered in site evaluation, and in the design, construction, and operation of the ISFSI.

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

200 **(TVA/OP/EDT—83/11) Physical and chemical characteristics of Alabama tar sands.** Wilson, G.V. (Geological Survey, University, AL (USA)). 1983. 102p. NTIS, PC A06/MF A01. Order Number DE84900283.

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The tar sand deposits of northwest Alabama contain large reserves of oil, part of which may one day be tapped to supplement conventional oil production. The largest reserves occur in the Hartselle Sandstone and Price Mountain Formation, both of Mississippian age. Commercial developments of Alabama's tar sand deposits have been limited to operations in west-central Colbert County. Here to surface mine the material for use as road construction material. No attempt has been made to establish a commercial-scale oil extraction operation. The Hartselle Sandstone has the best potential for future oil extraction operations. Total reserves have been estimated to be in the order of about 3 billion barrels of oil in place. Much of Alabama's tar sand resource occurs in deposits that are relatively thin, lean, and somewhat discontinuous. The degree of oil saturation in the Hartselle Sandstone has a wide variation that is apparently related to lithofacies.

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 131, 132, 133, 200

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 201, 202

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 504

201 **(LA—9678-PR) Explosively produced fracture of oil shale. Progress report, October-December 1982.** (Los Alamos National Lab., NM (USA)). Jul 1983. Contract W-7405-ENG-36. 57p. NTIS, PC A04/MF A01. Order Number DE84002270.

The Los Alamos National Laboratory is conducting rock fragmentation research in oil shale to develop the blasting and fluid-flow technologies required to prepare a rubble bed for a modified in situ retort. The first section of this report details the continued planning for the DOE/Sandia/Los Alamos joint rock fragmentation program, including preliminary designs for the first stemming tests and the blasting mat experiment. Section I also describes our current and planned computer modeling program for rock fracture, tracer flow, and oil shale retorting. The second section presents three papers, two on computer modeling and theory and one on oil shale field experiments. The first describes the Bedded Crack Model and its theoretical basis. The second discusses a two-dimensional numerical model of underground oil shale retorting that fully couples retorting chemistry with fluid and heat flow. This paper condenses the code documentation manual, which will be published separately with a user's guide. The third paper focuses on the empirical characterization of 200 cratering experiments conducted in Piceance Creek Basin oil shale, evaluates scaling laws as a tool to predict large-scale experiment results, and investigates the influence of geology and shale grade on rock fragmentation.

202 **(LA—9783-PR) Explosively produced fracture of oil shale. Progress report, January-March 1983.** (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 78p. NTIS, PC A05/MF A01. Order Number DE84002296.

The Los Alamos National Laboratory is conducting rock fragmentation research in oil shale to develop the blasting and fluid-flow technologies required to prepare a rubble bed for a modified in situ retort. The first section of this report details progress on our joint rock fragmentation project with Sandia National Laboratories, including selection of an explosive for the experiments. We describe a study of the relationship between the speed of sound in the oil shale and the detonation velocity of the explosive. We also discuss the preshot fracture distribution calculations and experimental results predictions for the upcoming single-borehole tests at Anvil Points. Section I also lists the publications and presentations from our rock fragmentation research (July 1980 through the present). The second section summarizes the geologic influences on the Consortium fragmentation experiments at Anvil Points Mine.

203 **(UCRL—52000-83-10) Energy and technology review.** (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01. Order Number DE84002690.

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Three review articles are presented. The first describes the Lawrence Livermore Laboratory role in the research and development of oil-shale retorting technology through its studies of the relevant chemical and physical processes, mathematical models, and new retorting concepts. Second is a discussion of investigation of properties of dense molecular fluids at high pressures and temperatures to improve understanding of high-explosive behavior, giant-planet structure, and hydrodynamic shock interactions. Third, by totally computerizing the triple-quadrupole mass spectrometer system, the laboratory has produced a general-purpose instrument of unrivaled speed, selectivity, and adaptability for the analysis and

identification of trace organic constituents in complex chemical mixtures. (GHT)

0405 Properties And Composition

REFER ALSO TO CITATION(S) 190

204 **(UCID—19906) Determination of sulfur species in oil shales.** Bissell, E.R. (Lawrence Livermore National Lab., CA (USA)). Sep 1983. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01. Order Number DE84002086.

The method of Attar and Dupuis (1978, 1979) for sulfur in coal looked attractive. This method involves reduction of the sulfur species by hydrogen transfer in the presence of a molybdenum sulfide catalyst to produce hydrogen sulfide, which is detected with a flame photometer. Since the kinetics of reduction of each type of functional group should be different, each type should produce hydrogen sulfide at a different temperature if the sample, hydrogen donor and catalyst are heated through an increasing temperature ramp. This work was an attempt to remove some of the deficiencies of the existing system.

205 **The mechanical behavior of Anvil Points oil shale at elevated temperatures and confining pressures.** Zeuch, D.H. (Geomechanics Division 1542, Sandia National Lab., Albuquerque, NM 87185). *Canadian Geotechnical Journal;* 20: No. 2, 334-365(May 1983). Contract AC04-76DP00789.

Twenty-one constant-strain-rate compression tests have been performed on 80 mL/kg (20 gallons/ton) Anvil Points oil shale at elevated temperatures (50-200°C) and confining pressures (0.5-40 MPa). The strength of oil shale increases approximately linearly with confining pressure and decreases nonlinearly with temperature. Ductility is greatly enhanced by the application of confining pressure. Elevated temperatures have little influence on ductility at low confining pressures; however, temperature exerts a progressively more pronounced influence on ductility with increasing confining pressure. purely empirical failure law, incorporating the effects of temperature and confining pressure, has been fitted to the data. The failure law is in good agreement with the results of other studies on the compressive strength of oil shale.

0407 Health And Safety

REFER ALSO TO CITATION(S) 123

0409 Waste Research And Management

206 (LBL—15298, pp 4.44-4.51) **Oil shale wastewater treatment: effect of ozonation and uv irradiation on biorefractory organic solutes.** Jones, B.M.; Langlois, G.W.; Sakaji, R.H.; Thomas, J.F.; Daughton, C.G. (Univ. of California, Richmond, CA). Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Ozonation and uv irradiation were evaluated both for their ability to directly oxidize organic solutes and for their indirect influence on biodegradability through minor structural alterations of refractory compounds in Oxy-6 retort water. Possible mechanisms of organic solute alterations were investigated by determining organic carbon in reverse-phase fractions of time-course samples.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 182

207 (CONF-821199—, pp 15-24) **Elastic/plastic compaction model applicable to low cohesion oil sands reservoir.** Abou-Sayed, A.S. (Terra Tek International, Salt Lake City, UT). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The author states that compaction of deep oil reservoir layers due to fluid withdrawal affects both oil production drive mechanisms and surface subsidence. Severe compaction may also alter the formation permeability, lead to sand production and affect wellbore stability. Surface subsidence is related to reservoir compaction via the mechanical response of the overburden. In conventional oil and gas reservoirs it may be adequate to assume an elastic deformation in both reservoir and overburden layers. For the oil sands (shallow, low or no-cohesion soils), however, the situation is different. Irrecoverable deformation contributes substantially to the compaction problems in reservoirs of this type. The author concludes that comprehensive evaluation of the mechanical behavior of low-cohesion oil sands at moderate stress levels is essential to the prediction of reservoir compaction due to fluid withdrawal. Accurate evaluation of volume changes in the production layer during production is essential for predicting surface subsidence and reservoir oil drive mechanisms. The elastic (recoverable) and inelastic (irrecoverable) behavior of such material needs to be identified and adequately modeled for use in conjunction with reservoir models. Work done to develop an elastic-plastic compaction model to account for volume changes of fluid-saturated, weakly-cemented, sands and soft rocks is described. The concentrations between volume collapse and pore pressure changes are included. 46 references.

208 (CONF-821199—, pp 46-57) **Thermal expansion of oil sands.** Scott, J.D.; Kosar, K.M. (Univ. of Alberta, Edmonton). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The authors presented a discussion of thermal effects which is based on experience in Canada with the extraction of heavy oils. In situ extraction of bitumen from oil sands requires heating of the oil reservoir in order to reduce the viscosity of the bitumen to make it mobile. The oil sand expands upon heating with the amount of expansion dependence on the amount of drainage of the water and bitumen from the stimulated zone. The expansion causes ground deformation, which has an adverse effect on wells and casings, can cause formation fracturing and shear strains, and can produce large surface movements. If formation confining pressures are high and drainage is slow, the temperature increases will cause rapid pore fluid pressure increases with a resulting drop in effective stresses and shear strength. Volume change, and pore pressure increase experiments on oil sands when heated to temperature of 200°C are described. Each component contributing to volume change: water, bitumen, sand grains, and soil structure is examined separately and compared to that of undisturbed oil sand samples. The experimental values are compared to theoretical models for completely undrained and drained states. 12 references, 15 figures.

05 NUCLEAR FUELS

0502 Exploration

209 (GJBX—35-83-Prescott-B-AZ-Vol.2B) **Airborne gamma-ray spectrometer and magnetometer survey: Prescott B, AZ, detail area. Volume II B. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1983. Contract AC13-79GJ01692. 286p. NTIS, PC A13/MF A01. Order Number DE84002411.

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This volume contains eight appendices: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariant analysis maps, and geochemical factor analysis maps. This information pertains to Prescott B, Arizona.

210 (GJBX—35-83-Prescott-B-AZ-Vol.2A) **Airborne gamma-ray spectrometer and magnetometer survey: Prescott B, AZ, detail area. Volume II A. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1983. Contract AC13-79GJ01692. 393p. NTIS, PC A17/MF A01. Order Number DE84002412.

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Volume II A contains the geology of Prescott B detail area, radioactive mineral occurrences in Arizona, geophysical data inter-

pretation and eight appendices (stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, magnetic and ancillary profiles, and test line data).

211 **(GJBX—35-83-Prescott-A-AZ-Vol.2A) Airborne gamma-ray spectrometer and magnetometer survey: Prescott A, AZ, detail area. Volume II A. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1983. Contract AC13-79GJ01692. 385p. NTIS, PC A17/MF A01. Order Number DE84002748.

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Volume II A contains the geology of Prescott A detail area, radioactive mineral occurrences in Arizona, geophysical data interpretation and eight appendices (stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, magnetic and ancillary profiles, and test line data).

212 **(GJBX—35-83-Prescott-A-AZ-Vol.2B) Airborne gamma-ray spectrometer and magnetometer survey: Prescott A, AZ, detail area. Volume II B. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1983. Contract AC13-79GJ01692. 286p. NTIS, PC A13/MF A01. Order Number DE84002413.

Portions are illegible in microfiche products.

This volume contains eight appendices: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariant analysis maps, and geochemical factor analysis maps.

213 **(GJBX—35-83-Prescott-A-B-AZ-Vol.1) Airborne gamma-ray spectrometer and magnetometer survey, Prescott A,B AZ. Final report. Volume I. Detail area.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). [nd]. Contract AC13-79GJ01692. 96p. NTIS, PC E08/MF $9.50. Order Number DE84002507.

Portions are illegible in microfiche products; Includes 26 sheets of 48x reduction microfiche.

An airborne combined radiometric and magnetic survey was performed for the Department of Energy over the Prescott A and Prescott B Detail Areas of northwestern Arizona. Radiometric data were corrected for live time, aircraft and equipment background, cosmic background, atmospheric radon, Compton scatter, and altitude dependence. The corrected data were statistically evaluated, gridded, and contoured to produce maps of the radiometric variables, uranium, potassium, and thorium; their ratios; and the residual magnetic field. These maps have been analyzed in order to produce a multi-variant analysis contour map based on the radiometric response of the individual geological units. A geochemical analysis has been performed, using the radiometric and magnetic contour maps, the multi-variant analysis map, and factor analysis techniques, to produce a geochemical analysis map for the area. Volume I contains a description of the systems used in the survey, a discussion of the calibration of the systems, the data collection procedures, the data processing procedures, the data presentation, the interpretation rationale, and the interpretation methodology. Separate Volumes II-A and II-B for Detail Areas A and B contain the data displays and the interpretation results.

0503 Mining

REFER ALSO TO CITATION(S) 286

0504 Feed Processing

REFER ALSO TO CITATION(S) 286

214 **(CONF-831047—94) Po-210 distribution in uranium-mill circuits.** McKlveen, J.W.; Hubele, N.D.; McDowell, W.J.; Case, G.N. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences; Garrett Corp., Phoenix, AZ (USA). Pneumatic Systems Div.; Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE84002069.

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

Greater than 99% of all incoming Po-210 reports to the tailing piles for both the acid and the alkaline leach uranium circuits. Leached Po-210 may be carried along on small particles rather than dissolved in solution. There does not appear to be any radiologically significant buildup or accumulation in the acid leach circuit, but there are noteworthy amounts in the molybdenum recovery solution.

0505 Enrichment

REFER ALSO TO CITATION(S) 1015

215 **(K/PS—5024) Laser isotope separation techniques for target and other materials.** McCulla, W.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1983. Contract W-7405-ENG-26. 26p. (CONF-830927—3). NTIS, PC A03/MF A01. Order Number DE84001872.

From 7. international conference on crystal growth; Stuttgart, F.R. Germany (12 Sep 1983).

An overview of both atomic and molecular laser isotope separation techniques is presented. With the exception of uranium, most molecular experimental efforts have been concentrated on isotopes of $Z \leq 18$. Some of these efforts are reviewed along with successful atomic methods on isotopes of elements of $Z \geq 18$. The general application of laser isotope separation to isotopes in target and special nuclear materials preparation is discussed. 10 references, 11 figures, 3 tables.

216 **(UCRL-Trans—11912) Method for isotope separation.** Nebenzahl, I.; Levin, M. (Lawrence Livermore National Lab., CA (USA)). 24 Oct 1983. Contract W-7405-ENG-48. Translation of German Patent 2,312,194. 19p. NTIS, PC A02/MF A01. Order Number DE84002547.

The object of the invention is to carry out isotope separation by means of selective excitation and ionization by overcoming the problems formerly associated with this principle such that it is possible to attain a higher grade of purity in the desired isotopes, a significantly increased yield, and lower production costs. The separation technique of the invention can be used for elements which have two or more isotopes. The invention then is explained by using the example of the separation of ^{235}U and ^{238}U. It is obvious that other isotopes can be separated from one another by suitable matching (tuning) of the method.

217 **An evaluation of uranium enrichment by mass diffusion.** Forsberg, C.W.; Benedict, M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *AIChE (American Institute of Chemical Engineers) Symposium Series;* **78**: No. 221, 24-30(1982).

This paper summarizes the design of a process to separate uranium isotopes by mass diffusion of uranium hexafluoride into perfluorobutylamine and gives estimates of the energy consumption, capital cost, and overall cost per unit of separative work. Comparison of this mass diffusion process with gaseous diffusion shows that mass diffusion needs about 20% more stages, has about three times the available energy consumption, and the cost of separative work would be almost five times that by gaseous diffusion. Mass diffusion may, however, have economic application for small-scale separation of isotopes of other elements than uranium.

218 **Evaluation of uranium enrichment processes.** Vanstrum, P.R.; McGill, R.M.; Wilcox, Wm.J. (Union Carbide Corporation, Nuclear Division, Oak Ridge, Tennessee). *AIChE (American Institute of Chemical Engineers) Symposium Series;* **78**: No. 221, 93-98(1982).

Uranium enrichment is an important and complex business characterized by uncertainties in many key variables affecting enrichment program plans. Central to analysis of enrichment plans to meet specific objectives are technical and economic assessments, particularly for new processes. These enrichment process characteristics are considered in the context of enrichment business parameters; such as demand; production capacity and stockpile management; and feed requirements, availability, and costs. This paper pre-

sents a description of methodology and current results of evaluation of U.S. enrichment technologies, together with a summary of the strategic implications.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 493, 817, 962, 1568

219 **Review of direct electrical heating experiments on irradiated mixed-oxide fuel.** Fenske, G.R.; Bandyopadhyay, G. (Argonne National Laboratory, IL (USA)). pp 311-322 of Actes de la conference de Lyon. Vol. 4 (Proceedings of the LMFBR safety topical meeting. Vol. 4). Paris, France; SFEN (1982). (CONF-820704—).

From International topical meeting on LMFBR safety; Lyon, France (18 Jul 1982).

Results of approximately 50 out-of-reactor experiments that simulated various stages of a loss-of-flow event with irradiated fuel are presented. The tests, which utilized the direct electrical heating technique to simulate nuclear heating, were performed either on fuel segments with their original cladding intact or on fuel segments that were extruded into quartz tubes. The test results demonstrated that the macro- and microscopic fuel behavior was dependent on a number of variables including fuel heating rate, thermal history prior to a transient, the number of heating cycles, type of cladding (quartz vs stainless steel), and fuel burnup.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 247, 248, 877, 881, 890

220 **(DP-MS—83-76) Reprocessing RERTR fuels.** Rodrigues, G.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 12p. (CONF-8310176—1). NTIS, PC A02/MF A01. Order Number DE84001593.

From International meeting on reduced enrichment for research and test reactors; Tokai, Japan (24 Oct 1983).

The Reduced Enrichment Research and Test Reactor Program is one element of the United States Government's nonproliferation effort. High density, low enrichment aluminum-clad dispersed uranium compound fuels may be substituted for the highly enriched aluminum-clad aluminum-uranium alloy fuels now in use. Savannah River Laboratory has performed studies which demonstrate reprocessability of spent RERTR fuels at Savannah River Plant. Results of dissolution and feed preparation tests with both unirradiated and irradiated (up to approximately 90% burnup) fuels are presented. 13 references, 2 figures, 4 tables.

221 **(DP-MS—83-103) Recovery of plutonium from molten salt extraction residues.** Gray, L.W.; Holcomb, H.P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1983. Contract AC09-76SR00001. 32p. (CONF-8310185—1). NTIS, PC A03/MF A01. Order Number DE84001534.

From 3. pyrochemistry workshop; Golden, CO, USA (25 Oct 1983).

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Savannah River Laboratory (SRL), Savannah River Plant (SRP), and Rocky Flats Plant (RFP) are jointly developing a process to recover plutonium from molten salt extraction residues. These NaCl, KCl, $MgCl_2$ residues, which are generated in the pyrochemical extraction of ^{241}Am from aged plutonium metal, contain up to 25 wt % dissolved $PUCl_3$ and up to 2 wt % $AmCl_3$. The objective is to develop a process to convert these residues to plutonium metal product and discardable waste. The first step of the conceptual process is to convert the actinides to a heterogenous scrub alloy with aluminum and magnesium. This step, performed at RFP, effectively separates the actinides from the bulk of the chloride. This scrub alloy will then be dissolved in a HNO_3-HF solution at SRP. Residual chloride will be removed by precipitation with $Hg_2(NO_3)_2$ followed by centrifugation. Plutonium and americium will be separated using the Purex solvent extraction process. The ^{241}Am will be diverted to the solvent extraction waste stream where it can either be discarded to the waste farm or recovered. The plutonium will be finished via PuF_3 precipitation, oxidation to a mixture of PUF_4 and PuO_2, followed by reduction to plutonium metal with calcium.

222 **(RHO-PB-SR—10B-CP-8/83) Rockwell Hanford Operations chemical processing monthly report, August 1983.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Aug 1983. Contract AC06-77RL01030. 60p. NTIS, PC A04/MF A01. Order Number DE84001904.

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Combined saltwell jet pump production for TX and BY Tank Farms in the month of August was 140,000 gallons. The fiscal year-to-date volume pumped from TX, TY and BY Tank Farms is 649,000 gallons versus 650,000 gallons planned. Thirty-five cesium and sixteen strontium capsules were produced in August for a year-to-date total of 138 and 141, respectively. Tank 103-TX was declared Interim Stabilized in August. Consultation with US DOE has resulted in a change of project strategy from use of double-shell tanks to use on low-level customer waste in shallow land disposal vaults. DOE-RL has requested the Functional Design Criteria (approved) to be officially modified and the Conceptual Design Report, now in approval process, to be modified. A total of 96 acres has been surface stabilized fiscal year-to-date exceeding the milestone of 41 acres.

223 **(RHO-PB-SR—10-B-CP-June-83) Chemical processing monthly report, June 1983.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1983. Contract AC06-77RL01030. 58p. NTIS, PC A04/MF A01. Order Number DE83016172.

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Shipment of the initial stable material from PNL 303-C Building in support of the Hanford Plutonium Scrap Processing Plan was initiated. Six shipments have been completed on schedule per the 303-C Shipping and Receiving Plan. Another PUREX Phase ID enhanced readiness test run of two weeks was successfully completed. The task to modify nine railroad well cars for PUREX fuel transportation support was completed one month ahead of schedule. The performance specification for the Helicopter Hangar/Support Facility (B-458) was approved by Kaiser Engineers Hanford (KEH) and Rockwell Hanford Operations (Rockwell) on schedule.

224 **Method for cleaning solution used in nuclear fuel reprocessing.** Tallent, O.K.; Dodson, K.E.; Mailen, J.C. (to U S Dept. of Energy). US Patent 4,394,269. 19 Jul 1983. Filed date 12 May 1981. vp.

PAT-APPL-262831.

A nuclear fuel processing solution containing (1) hydrocarbon diluent, (2) tri-n-butyl phosphate or tri-2-ethylhexyl phosphate, and (3) monobutyl phosphate, dibutyl phosphate, mono-2-ethylhexyl phosphate, di-2-ethylhexyl phosphate, or a complex formed by plutonium, uranium, or a fission product thereof with monobutyl phosphate, dibutyl phosphate, mono-2-ethylhexyl phosphate, or di-2-ethylhexyl phosphate is contacted with silica gel having alkali ions absorbed thereon to remove any one of the degradation products named in section (3) above from said solution.

225 **Molten tin reprocessing of spent nuclear fuel elements.** Heckman, R.A. (to US Dept. of Energy). US Patent 4,392,995. 12 Jul 1983. Filed date 19 Dec 1980. vp.

PAT-APPL-218242.

A method and apparatus for reprocessing spent nuclear fuel is described. Within a containment vessel, a solid plug of tin and nitride precipitates supports a circulating bath of liquid tin therein. Spent nuclear fuel is immersed in the liquid tin under an atmosphere of nitrogen, resulting in the formation of nitride precipitates. The layer of liquid tin and nitride precipitates which interfaces the plug is solidified and integrated with the plug. Part of the plug is melted, removing nitride precipitates from the containment vessel, while a portion of the plug remains solidified to support the liquid tin and nitride precipitates remaining in the containment vessel. The process is practiced numerous times until substantially all of the precipitated nitrides are removed from the containment vessel.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 813, 985

226 **(BMFT-FB-K—83-001) Cost/benefit analysis for a temporary nuclear storage facility.** Jex, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1983. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83751311.

The subject report gives cost/benefit considerations as related to calculating a risk of nuclear temporary storage, in order to achieve a cost-affecting risk reduction to a specified risk value Rsub(o). The risk analysis is oriented towards a faulted load condition sequence in order to determine the frequency of "fuel bundle melting". Consideration of the risk as a function of the number of cooling loops, emergency power feed lines with emergency Diesel and the venting loops shows that the cost/risk relation is mainly affected by a variation of cooling loops.

227 **(NUREG/CR—3445) Cost-benefit analysis of unfired PuO_2 pellets as an alternative plutonium shipping form.** Mishima, J.; Brackenbush, L.W.; Libby, R.A.; Soldat, K.L.; White, G.D. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 48p. (PNL—4806). NTIS, PC A03/MF A01 - GPO $4.00. Order Number DE84001874.

A limited cost-benefit evaluation was performed concerning use of unfired plutonium dioxide pellets as a shipping form. Two specific processing operations are required for this use, one to form the pellet (pelletizing) and a second to reconstitute an acceptable powder upon receipt (reconstitution). The direct costs for the pelletizing operation are approximately $208,000 for equipment and its installation and $122 per kg of plutonium processed (based upon a 20-kg plutonium/day facility). The direct costs for reconstitution are approximately $90,000 for equipment and its installation and $81 per kg of plutonium processed. The indirect cost considered was personnel exposure from these operations. Whole body exposures ranged from 0.04 man-rem per 100 kg of low-exposure plutonium reconstituted to 0.9 man-rem per 100 kg of average-exposure plutonium pelletized. Hand exposures were much higher - 17 man-rem power 100 kg of low-exposure plutonium reconstituted to 67 man-rem per 100 kg of average plutonium pelletized. The principal benefit is a potential twentyfold reduction of airborne release in the event of an accident. An experimental plan is outlined to fill the data gaps uncovered during this study in the areas of pelletizing and reconstitution process parameters and pellet response behavior to accident-generated stresses. A study to enhance the containment potential of the inner packaging used during shipment is also outlined.

228 **(ORNL/TM—8759) HIGHWAY, a transportation routing model: program description and revised users' manual.** Joy, D.S.; Johnson, P.E. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 67p. NTIS, PC A04/MF A01. Order Number DE84002263.

A computerized transportation routing model has been developed at the Oak Ridge National Laboratory to be used for predicting likely routes for shipping radioactive materials. The HIGHWAY data base is a computerized road atlas containing descriptions of the entire Interstate System, the federal highway system, and most of the principal state roads. In addition to its prediction of the most likely commercial route, options incorporated in the HIGHWAY model can allow for maximum use of Interstate highways or routes that will bypass urbanized areas containing populations greater than 100,000 persons. The user may also interactively modify the data base to predict routes that bypass any particular state, city, town, or specific highway segment.

229 **American National Standard: design criteria for an independent spent-fuel-storage installation (water pool type).** La Grange Park, IL; American Nuclear Society (1981). 53p. (ANSI/ANS—57.7-1981). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $35.00.

This standard provides design criteria for systems and equipment of a facility for the receipt and storage of spent fuel from light water reactors. It contains requirements for the design of major buildings and structures including the shipping cask unloading and spent fuel storage pools, cask decontamination, unloading and loading areas, and the surrounding buildings which contain radwaste treatment, heating, ventilation and air conditioning, and other auxiliary systems. It contains requirements and recommendations for spent fuel storage racks, special equipment and area layout configurations, the pool structure and its integrity, pool water cleanup, ventilation, residual heat removal, radiation monitoring, fuel handling equipment, cask handling equipment, prevention of criticality, radwaste control and monitoring systems, quality assurance requirements, materials accountability, and physical security. Such an installation may be independent of both a nuclear power station and a reprocessing facility or located adjacent to any of these facilities in order to share selected support systems. Support systems shall not include a direct means of transferring fuel assemblies from the nuclear facility to the installation.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 233

0520 Waste Management

REFER ALSO TO CITATION(S) 286, 287, 288, 291, 518, 760, 1319, 1388, 1400, 1401, 1402, 1405

230 **(BNL-NUREG—33579) Uncertainties in the thermodynamics of basalt-oxygen and basalt-water reactions.** Schweitzer, D.G.; Davis, M.S. (Brookhaven National Lab., Upton, NY (USA)). Aug 1983. Contract AC02-76CH00016. 10p. (CONF-8308126—2). NTIS, PC A02/MF A01 - GPO. Order Number DE84001458.

From NRC research annual review meeting of nuclear waste management research on geochemistry of HLW disposal; Reston, VA, USA (30 Aug 1983).

A knowledge of basalt-oxygen equilibria and basalt-water equilibria are required to predict the performance of a high-level waste package in a basalt repository. In this report we have evaluated uncertainties in these equilibria using thermodynamic data from two sources, the JANAF Thermochemical Tables (1971) and from Kubaschewski (1974). Our analysis indicates that the uncertainties in the basic thermodynamic data lead to 30 orders of magnitude in uncertainty in the oxygen fugacity for the magnetite-hematite reaction (10^{-57} to 10^{-86} atm) and about 15 orders of magnitude uncertainty in the hydrogen equilibrium pressure (10^{-12} to 10^{+3} atm). A vast volume of literature exists on reactions involving magnetite and hematite in water at temperatures pertinent to basalt repositories (50° to 350°C). These data show that Fe_3O_4 and Fe_2O_3 can coexist in water with oxygen fugacities from about 10^{-4} to 1 rather than the calculated oxygen fugacities of $\sim 10^{-60}$ to 10^{-30} assumed in the past. 5 references.

231 **(DOE/ET/44112—T1) Nuclear waste: what to do with it. Academy forum.** (National Academy of Sciences, Washington, DC (USA)). 19 Nov 1979. Contract AC01-80ET44112. 45p. NTIS, PC A03/MF A01. Order Number DE84001181.

The dialogue from the Forum on nuclear waste disposal is presented.

232 **(DOE/ID/12371—1) Strategy and plan for siting and licensing a Rocky Mountain low-level radioactive waste facility.** Whitman, M. (Colorado State Government, Denver (USA)). Sep 1983. Contract FG07-82ID12371. 23p. NTIS, PC A02/MF A01. Order Number DE84001148.

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In 1979, the States of Nevada and Washington temporarily closed their commercial low-level radioactive waste (LLW) disposal facilities and South Carolina, the only other state hosting such a facility, restricted the amount of waste it would accept. All three states then announced that they did not intend to continue the status quo of accepting all of the country's commercial low-level radioactive waste. Faced with this situation, other states began con-

sidering alternative LLW management and disposal options. In the Rocky Mountain region, this evolved into discussions for the development of an interstate compact to manage low-level waste. Inherent in this management plan was a strategy to site and license a new LLW disposal facility for the Rocky Mountain region. The Rocky Mountain Low-Level Radioactive Waste Compact was negotiated over the course of a year, with final agreement on the language of the compact agreed to in early 1982. States eligible to join the compact are Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming. Colorado adopted the compact into law in 1982, and Nevada, New Mexico and Wyoming adopted it in 1983. Utah has joined the Northwest Compact, although it may decide to join the Rocky Mountain Compact after a new disposal facility is developed for the region. Arizona has taken no action on the Rocky Mountain Compact.

233 **(DOE/ID/12371—6) Economics of a low-level radioactive waste management facility for the Rocky Mountain region.** Whitman, M.; Slosky, L.; Mizner, S.; Murphy, C. (Colorado State Government, Denver (USA)). Sep 1983. Contract FG07-82ID12371. 70p. NTIS, PC A04/MF A01. Order Number DE84001146.

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Several low-level radioactive waste management techniques are examined to consider the pros and cons of their application in the Rocky Mountain region. Those techniques include shallow land burial, greater confinement disposal, near surface facilities, abandoned mines incineration and other volume reduction techniques, temporary storage for decay, and biological waste treatment options. Special handling needs for the low-level waste categories established by the US Nuclear Regulatory Commission in 10 CFR 61 are also explored.

234 **(DOE/LLW—2) Understanding low-level radioactive waste. National Low-Level Radioactive Waste Management Program.** (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1983. Contract AC07-76ID01570. 121p. NTIS, PC A06/MF A01. Order Number DE84001913.

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Chapters are devoted to: background and policymaking for low-level waste management; commercial low-level waste generation; Department of Energy low-level waste generation; low-level waste treatment; packaging and transportation; commercial low-level waste disposal; Department of Energy low-level waste disposal; Department of Energy low-level waste management program; and laws and regulations.

235 **(DOE/NE/46640—8) Consultation and concurrence for NWTS in crystalline rock. ONWI quarterly report, April 1-June 30, 1983.** Anderson, W. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). 7 Oct 1983. Contract FG02-81NE46640. 4p. NTIS, PC A02/MF A01. Order Number DE84002358.

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The major activity for the NWTS program in Maine was scheduling a briefing by DOE and Battelle personnel for Maine executive and legislative officials. The briefing was held April 27, 1983, in Augusta, and was followed several days later by an MGS briefing before the Legislative Commission on Energy and Natural Resources. The MGS received copies of the Draft Northeast Regional Characterization reports for review, and made arrangements with the Maine Department of Transportation, State Planning Office, Department of Environmental Protection, and Department of Inland Fisheries and Wildlife for review of various parts of the documents. MGS staff attended the May 11, 1983, meeting between DOE and the States to discuss the draft General Guidelines for Site Recommendation. A follow-up meeting was held with DOE and Battelle staff and State officials in Augusta June 15, 1983. MGS and State Planning Office staff attended the screening methodology workshop held in late June in Columbus at Battelle. Bedrock and surficial map activities centered exclusively around preparation of mockup copies of the map for peer review. It is anticipated the maps would go out for review in mid-July.

236 **(DOE/NE/46640—9) Consultation and concurrence for NWTS in crystalline rock. Progress report, July 1, 1983-September 30, 1983.** Anderson, W. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). 1983. Contract FG02-81NE46640. 4p. NTIS, PC A02/MF A01. Order Number DE84002357.

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Staff from the Maine Geological Survey and the Governor's Office attended the August 17-18, 1983, second meeting between the States and DOE regarding the General Guidelines for Site Recommendation; subsequent to the meeting a letter was sent from Governor Brennan to Secretary Hodel expressing support for several state positions taken at the August meeting. Peer review copies of the state bedrock and surficial map were completed and sent to geologists in New Hampshire, New Brunswick, and Quebec for their critical comments. Copies were forwarded to Battelle and DOE/Chicago. Completed reviews were received in late August, and a chief editors' meeting was held in Augusta in early September to generate final changes to the line work and the text. These changes were received in late September and are presently being made. Input of base information necessary for geographic coding and retrieval of bibliographic citations was completed, and work on inputting the topical keywords and geocodes for each citation was started.

237 **(DOE/NE/93031—T1) Study of the isolation system for geologic disposal of radioactive wastes.** (National Academy of Sciences, Washington, DC (USA)). 1983. Contract AT01-80NE93031. 356p. NTIS, PC A16/MF A01. Order Number DE84001084.

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This study was conducted for the US Department of Energy by a Waste Isolation System Panel of the Board on Radioactive Waste Management under the National Research Council's Commission on Physical Sciences, Mathematics, and Resources. The panel was charged to review the alternative technologies available for the isolation of radioactive waste in mined geologic repositories, evaluate the need for and possible performance benefits from these technologies as potential elements of the isolation system, and identify appropriate technical criteria for choosing among them to achieve satisfactory overall performance of a geologic repository. Information has been acquired through examination of a large body of technical literature, briefings by representatives of government agencies and their industrial and university contractors, in-depth discussions with individual experts in the field, site visits, and calculations by panel members and staff, with deliberations extending over a period of approximately two years. The panel's principal findings are given. Chapters are devoted to: the geologic waste-disposal system; waste characteristics; waste package; conceptual design of repositories; geologic hydrologic, and geochemical properties of geologic waste-disposal systems; overall performance criterion for geologic waste disposal; performance analysis of the geologic waste-disposal system; and natural analogs relevant to geologic disposal. 336 references.

238 **(DP-MS—82-97) Theoretical predictions for glass flow into an evacuated canister.** Routt, K.R.; Crow, K.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 25p. (CONF-830451—25). NTIS, PC A02/MF A01. Order Number DE84001754.

From American Ceramic Society annual meeting; Chicago, IL, USA (25 Apr 1983).

Radioactive waste currently stored at the Savannah River Plant in liquid form is to be immobilized by incorporating it into a borosilicate glass. The glass melter for this process will consist of a refractory lined, steel vessel operated at a glass temperature of 1150°C. At the end of a two-year projected melter lifetime, the glass inside the melter is to be drained prior to disposition of the melter vessel. One proposed technique for accomplishing this drainage is by sucking the glass into an evacuated canister. The theoretical bases for design of an evacuated canister for draining a glass melter have been developed and tested. The theoretical equations governing transient and steady-state flow were substantiated with both a silicone glass simulant and molten glass.

239 **(DP-MS—83-75) Solidification of ash from incineration of low-level radioactive waste.** Roberson, W.A.; Albenesius, E.L.; Becker, G.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 20p. (CONF-8310186—1). NTIS, PC A02/MF A01. Order Number DE84001530.

From Symposium on the GEM experience - an American education success story; Laurel, MD, USA (18 Oct 1983).

The safe disposal of both high-level and low-level radioactive waste is a problem of increasing national attention. A full-scale incineration and solidification process to dispose of suspect-level and low-level beta-gamma contaminated combustible waste is being demonstrated at the Savannah River Plant (SRP) and Savannah River Laboratory (SRL). The stabilized wasteform generated by the process will meet or exceed all future anticipated requirements for improved disposal of low-level waste. The incineration process has been evaluated at SRL using nonradioactive wastes, and is presently being started up in SRP to process suspect-level radioactive wastes. A cement solidification process for incineration products is currently being evaluated by SRL, and will be included with the incineration process in SRP during the winter of 1984. The GEM alumnus author conducted research in a related disposal solidification program during the GEM-sponsored summer internship, and upon completion of the Masters program, received full-time responsibility for developing the incineration products solidification process.

240 **(DP-MS—83-90) Savannah River Plant incinerator demonstration.** Lewandowski, K.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1983. Contract AC09-76SR00001. 13p. (CONF-8308106—21). NTIS, PC A02/MF A01. Order Number DE84001536.

From 5. annual participants information meeting of DOE low level waste management program; Denver, CO, USA (30 Aug 1983).

A full-scale incineration process was demonstrated at the Savannah River Laboratory (SRL) using nonradioactive waste. From October 1981 through September 1982, 15,700 kilograms of solid waste and 5.7 m^3 of solvent were incinerated. Emissions of off-gas components (NO/sub x/, SO_2, CO, and particulates) were well below South Carolina state standards. Volume reductions of 20:1 for solid waste and 7:1 for Purex solvent/lime slurry were achieved. The process has been relocated and upgraded by the Savannah River Plant to accept low-level beta-gamma combustibles. During a two-year demonstration, the facility will incinerate slightly radioactive (< 1.7 mCi/m^3) solvent and suspect level (< 1 mR/h @ 0.0254 meter) solid wastes. This demonstration will begin in early 1984.

241 **(DPST—81-212) Effect of formic acid elutriant concentration on cesium elution from Duolite CS-100.** Ebra, M.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 12 Jan 1981. Contract AC09-76SR00001. 11p. NTIS, PC A02/MF A01. Order Number DE84001532.

Adjustment of the formic acid concentration results in the separation of sodium from cesium during the elution of CS-100. As the formic acid concentration decreases from 2M to 0.1M, sodium elutes progressively earlier with respect to cesium. At 0.1M formic acid the two peaks are about 95% resolved. The total volume of elutriant required to elute all the cesium doubles in going from 2M to 0.1M formic acid. This could result in a 19% increase in total cycle time, assuming present TDS specified flows are maintained. Continuous monitoring of either conductivity or pH can be used to detect completion of the sodium elution.

242 **(EGG-FM—6045) Evaluation of forms for the immobilization of high-level and transuranic wastes.** Schuman, R.P.; Cox, N.D.; Gibson, G.W.; Kelsey, P.V. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1982. Contract AC07-76ID01570. 95p. NTIS, PC A05/MF A01. Order Number DE84002613.

A figure-of-merit (FOM) analysis has been made of a number of waste forms for solidifying both defense and commercial high-level reprocessing waste (HLW) and transuranic (TRU) wastes. The evaluation includes iron-enriched basalt (IEB), a fusion-produced glass-ceramic, which has not been included in other assessments. For HLW, concrete receives the highest FOM, but may not meet regulatory requirements; IEB and glass are the best choices of the materials that should easily meet regulatory requirements. Concrete waste forms are the best choice for TRU wastes, with IEB a close contender. 116 references, 3 figures, 112 tables.

243 **(EPRI-NP—3225) Assessment of power reactor waste immobilization by vitrification. Final report.** Larson, D.E.; Buelt, J.L.; Heath, W.O.; Partain, W.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1983. Contract AC06-76RL01830. 159p. NTIS, PC A08/MF A01. Order Number DE84001893.

A study was performed to determine the technical and economic viability of applying vitrification to volume reduction and immobilization of nuclear power plant radioactive waste (radwaste). Vitrification technology has been extensively developed in the United States and abroad for immobilization of high-level radioactive waste. A conceptual design of a facility to vitrify light-water reactor radwaste (except noncompactible/noncombustible wastes) was developed. Technical, economic, and safety evaluations were performed for waste vitrification. Technical and economic comparisons were made with available technologies for radwaste volume reduction and immobilization. It was concluded that vitrification is a viable and competitively attractive approach; however, some additional process verification should be conducted prior to plant application.

244 **(HW—77503) Plutonium Reclamation Facility: Chemical Processing Department Hazards Review Task Force report.** Brown, C.L.; Judson, B.F.; Swain, E.O. (General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation). 15 May 1963. 63p. NTIS, PC A04. Order Number DE84001845.

Paper copy only, copy does not permit microfiche production.

Construction of a new plutonium reclamation facility at Hanford was authorized by the Atomic Energy Commission on February 17, 1961, as Project CAC-880. The purpose of the new facility is to reclaim plutonium from both liquid and solid wastes generated from process operations in the 234-5 Building. The new building and most of the process equipment are now under construction with beneficial use anticipated for January 1964. In July 1962, the management of the Chemical Processing Department established a Task Force to review and evaluate potential hazards associated with start-up and operation of the 880 facility. The Task Force met twenty times during 1962 and 1963 reviewing available drawings and questioning knowledgeable process and design engineers. Comments and suggestions arising from the discussions were, for the most part, promptly incorporated into the design. This report describes briefly process and equipment in the Plutonium Reclamation Facility, outlines potentially serious incidents envisioned by the Task Force, summarizes principal hazards associated with the project, and evaluates the hazards controls incorporated into the design.

245 **(HW—77503-Rev.1) Plutonium Reclamation Facility: Chemical Processing Department Hazards Review Task Force report. Revision 1.** Brown, C.L.; Judson, B.F.; Swain, E.O. (General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation). 12 Aug 1963. 68p. NTIS, PC A04. Order Number DE84001561.

Paper copy only, copy does not permit microfiche production.

Construction of a new plutonium reclamation facility at Hanford was authorized by the Atomic Energy Commission on February 17, 1961, as Project CAC-880. The purpose of the new facility is to reclaim plutonium from both liquid and solid wastes generated from process operations in the 234-5 Building. The new building and most of the process equipment are now under construction with beneficial use anticipated for January 1964. In July 1962, the management of the Chemical Processing Department established a Task Force to review and evaluate potential hazards associated with start-up and operation of the 880 facility. The Task Force met twenty times during 1962 and 1963 reviewing available drawings

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246 (IAEA-SR—72, pp 266-279) **Laboratory tests of activated carbon for methyl iodide retention: influence of various parameters.** Deuber, H.; Gerlach, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/34).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

This paper contains results of parametric tests which were performed to quantitatively illustrate the retention of CH_3 ^{131}I by an activated carbon widely used in iodine filters of nuclear power plants, in a range of parameters relevant to laboratory tests or to iodine filter operation. Temperature, relative humidity and face velocity distinctly influence the performance index whereas preconditioning time (at >=20 h), injection time and purging time exhibit little or no influence on the performance index.

247 (IAEA-SR—72, pp 390-396) **Combination of head-end off-gas cleaning with a tritium concentrating step.** Goossens, W.R.A.; Collard, G.E.R.; Bruggeman, A. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/02).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

The integrated cleaning process for head-end off-gas such as developed by S.C.K./C.E.N. at Mol has the potential to reduce the concentration of I-129 and Kr-85 in the stack gases to very small levels compatible with anticipated more stringent regulations. The addition of conditioning steps for the isotopes trapped allows to conclude that 99.9% of the iodine present in the dissolver off-gas can be trapped and converted to copper iodide; that 99.9% of the krypton present can be transferred to a small gas bottle and that at the same time the tritium containing effluents of a reprocessing plant can be concentrated for 90% in a volume which is only 1% of the initial tritium contaminated water volume.

248 (IAEA-SR—72, pp 411-416) **Features and problems of a cryogenic krypton-separation process.** von Ammon, R.; Bumiller, W.; Hutter, E.; Knittel, G.; Mas, C.; Neffe, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/17).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

The most essential step for the separation of ^{85}Kr from the off-gas of reprocessing plants is the low-temperature rectification of the liquefied gas mixture. It consists of two columns: in the first one the carrier gas N_2 together with other low-boiling components like Ar and O_2 are driven off at the column-head, whereas Kr and Xe are collected in the bottom. The reboiler liquid is transferred after evaporation to the second column, where Kr is separated from Xe. Both products are transferred to intermediate storage vessels and from there to steel cylinders by means of cryogenic pumping or by a membrane compressor. All cryogenic parts including a heat exchanger are placed in a vacuum tank for thermal insulation. The cryogenic columns must be kept free from all gas components which might freeze out, thus causing plugging, or which might accumulate in a Kr-rich column section and give rise to radiolytic reactions. Therefore several purification steps are necessary for the process gas before the cryogenic part. These include: catalytic reduction of O_2 and NOsub(x) with H_2 (8) and adsorption of H_2O, CO_2, NH_3 and other high boiling impurities on molecular sieves.

240 (IAEA-SR—72, pp 417-431) **Laboratory experiments on adsorptive retention of Kr-85 from dissolver off-gas.** Ringel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/20).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

A method for separating radioactive krypton from the off-gas of a dissolver in a reprocessing plant based on the principle of adsorption and desorption on adsorbents is described. The laboratory experiments corroborate the feasibility of the individual process steps. The entire process essentially consists of three interconnected stages: - Retention of NOsub(x) residues and tritiated water on a molecular sieve and recycling both species with part of the waste gas into the dissolver. - Separation of xenon from the off-gas by activated charcoal with simultaneous concentration of krypton in the off-gas. - Separation of krypton from the residual off-gas by means of preparative gas chromatography and deposition of the pure krypton into storage cylinders containing activated charcoal. Based on the experiments a principle layout for a full scale off-gas cleaning system is described.

250 (ILR-MITT—119) **Appraisal of a target-relevant evaluation of alternative strategies for global radioactive waste disposal.** Koelle, H.H.; Apel, U.; Balzer, R.; Brieskorn, D.; Dorbandt, J.; Feuerstein, D.W.; Kill, H.; Koch, J.U.; Leukel, R.; Mueller, H. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt). 15 Feb 1982. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83751326.

This report results from a project within the course "Systems Engineering" during the winter semester 1982/83. The subject was to analyse alternatives for global nuclear waste disposal for the time period of 1980 through 2030. Terrestrial and extraterrestrial alternatives, four each, were considered. 33 objectives, arranged in a formal hierarchical system, were developed to the purpose of valuation. The priorities for these objectives were simulated from the viewpoint of 16 different interest groups. - Individual valuations for low-, medium- and high-level radioactive waste were performed on the basis of the weighted objectives. This led to a ranking of the alternatives for each of the three types of waste. It is shown that the extraterrestrial alternatives (e.g. backside of the moon) are quite attractive particularly for the high-level radioactive waste.

251 (LA—9793-PR) **Research and development related to the Nevada Nuclear Waste Storage Investigations. Progress report, January 1-March 31, 1983.** Wolfsberg, K.; Vaniman, D.T.; Ogard, A.E. (comps.). (Los Alamos National Lab., NM (USA)). Jun 1983. Contract W-7405-ENG-36. 54p. NTIS, PC A04/MF A01. Order Number DE84002271.

This report summarizes the contribution of the Los Alamos National Laboratory to the Nevada Nuclear Waste Storage Investigations for the second quarter of FY 1983. The status of the following studies is reported: field experiments on nuclide migration in tuff; geochemistry of tuff; mineralogy-petrology of tuff; volcanism; rock physics; shaft and borehole sealing; exploratory shaft; and quality assurance.

252 (LA-UR—83-3024) **Los Alamos controlled-air incineration studies.** Koenig, R.A.; Warner, C.L. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 15p. (CONF-8308106—22). NTIS, PC A02/MF A01. Order Number DE84001737.

From 5. annual participants information meeting of DOE low level waste management program; Denver, CO, USA (30 Aug 1983).

Current regulations of the Environmental Protection Agency (EPA) require that PCBs in concentrations greater than 500 ppM be disposed of in EPA-permitted incinerators. Four commercial incineration systems in the United States have EPA operating permits for receiving and disposing of concentrated PCBs, but none can accept PCBs contaminated with nuclear materials. The first section of this report presents an overview of an EPA-sponsored program

for studying PCB destruction in the large-scale Los Alamos controlled-air incinerator. A second major FY 1983 program, sponsored by the Naval Weapons Support Center, Crane, Indiana, is designed to determine operating conditions that will destroy marker smoke compounds without also forming polycyclic aromatic hydrocarbons (PAHs), some of which are known or suspected to be carcinogenic. We discuss the results of preliminary trial burns in which various equipment and feed formulations were tested. We present qualitative analyses for PAHs in the incinerator offgas as a result of these tests.

253 **(MLM—3102) Tritium control: October 1982-March 1983.** Lamberger, P.H.; Rogers, M.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 7 Oct 1983. Contract AC04-76DP00053. 24p. NTIS, PC A02/MF A01. Order Number DE84001891.

Surveys in gloveboxes indicated surface activity on stainless steel and its apparent dependence on time and atmospheric tritium levels. Surveys in fumehoods were completed to investigate the extent of surface contamination on surfaces of various materials. Gas generation rates caused by radiolysis of tritiated waste materials were determined for polymer and nonpolymer-impregnated tritiated concrete and fixated and nonfixated tritiated waste vacuum pump oil. In addition, the pressure change of hydrogen cover gas over tritiated water on cement-plaster was determined. The test program to measure and compare the release of tritium from tritiated concrete with and without styrene impregnation continued. Tritium permeation data from small test blocks are given. The drum study monitoring the release of tritium from actual burial packages continued. The maximum fractional release rate for the three types of high activity, tritiated liquid waste generated is 5.1×10^{-5}, and the maximum total permeation is 179 mCi after 8.5 yr. These two values represent a 13% increase for the past 6 months. Tritium release from the polymer-impregnated, tritiated concrete (PITC) and from the control (non-PITC) remains very low. The Emergency Containment System (ECS), an automatically actuated system developed at Mound to remove tritium from room air, has been modified and upgraded to support new applications. The leakage rate in the ECS area has been lowered, a fast-start system installed for greater conversion efficiency at startup, and the alumina beds regenerated.

254 **(N—8323954) Ocean dumping.** (Committee on Public Works and Transportation (U.S. House), Washington, DC). 1982. 265p. (GPO—11-258). Avail: Subcommittee on Water Resources.

In GPO Hearing on H.R. 6113 before the Subcomm. on Water Resource of the Comm. on Publ. Works and Transportation, 97th Congr., 2d Sess., 16 Jun. 1982.

The regulation of the dumping of materials into the ocean is reviewed. Criteria to be applied in reviewing and evaluating permit applications for the transportation and dumping of materials into the ocean are established. A definition of monitoring of dumping sites, the assessment of fees to cover permit processing costs, and a moratorium is placed on the issuance of permits for the disposal of radioactive waste are included.

255 **(NUREG/CR—3259) Leak detection systems for uranium mill tailings impoundments with synthetic liners.** Myers, D.A.; Tyler, S.W.; Gutknecht, P.J.; Mitchell, D.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 49p. (PNL—4694). NTIS, PC A03/MF A01 - GPO. Order Number DE84001179.

This study evaluated the performance of existing and alternative leak detection systems for lined uranium mill tailings ponds. Existing systems for detecting leaks at uranium mill tailings ponds investigated in this study included groundwater monitoring wells, subliner drains, and lysimeters. Three alternative systems which demonstrated the ability to locate leaks in bench-scale tests included moisture blocks, soil moisture probes, and a soil resistivity system. Several other systems in a developmental stage are described. For proper performance of leak detection systems (other than groundwater wells and lysimeters), a subgrade is required which assures lateral dispersion of a leak. Methods to enhance dispersion are discussed. Cost estimates were prepared for groundwater monitoring wells, subliner drain systems, and the three experimental systems. Based on the results of this report, it is suggested that groundwater monitoring systems be used as the primary means of leak detection. However, if a more responsive system is required due to site characteristics and groundwater quality criteria, subliner drains are applicable for ponds with uncovered liners. Leak-locating systems for ponds with covered liners require further development. Other recommendations are discussed in the report.

256 **(NUREG/CR—3382) Estimation of cesium-137 release from waste/cement composites using data from small-scale specimens.** Dayal, R.; Arora, H.; Morcos, N. (Brookhaven National Lab., Upton, NY (USA)). Jul 1983. Contract AC02-76CH00016. 64p. (BNL-NUREG—51690). NTIS, PC A04/MF A01 - GPO. Order Number DE84002392.

A study has been performed, correlating the leachability of Cs-137 from small-scale to large-scale waste/cement composites. In the study, simulants of two contrasting waste types were considered: cation-exchange resin and boric acid wastes incorporated in Portland Type cements. Test specimens were right cylinders of dimensions varying from 5 x 5 to 55 x 55 (diameter x height, cm). Using leach data representing diffusion-controlled release, effective diffusivities of $\sim 2 \times 10^{-8}$ cm^2/s have been calculated for Cs-137 in both waste/cement matrices. A comparison of the observed and predicted cesium release values indicated that leach data derived from testing of small-scale specimens can be extrapolated, using a planar semi-infinite medium approximation, to estimate leachability of a full-scale specimen.

257 **(NVO—196-34) Nevada Nuclear Waste Storage Investigations. Quarterly report, January-March, 1983.** (USDOE Nevada Operations Office, Las Vegas). Sep 1983. 75p. NTIS, PC A04/MF A01. Order Number DE84001834.

The Nevada Nuclear Waste Storage Investigations (NNWSI), include site-exploration and regional studies of the Nevada Test Site (NTS) area to establish whether a technically acceptable site exists for consideration as a potential location for one of the commercial nuclear waste repositories to be established. Yucca Mountain is located on and adjacent to the southwestern boundary of the NTS about 100 miles northwest of Las Vegas. The mountain is a long narrow ridge generally running north and south with a steep western slope and a gentler eastern slope. The underlying strata are inclined at three to eight degrees to the east. The ridge stands from about 1000 to 1200 feet above the surrounding alluvial flats. One of the characteristics that makes Yucca Mountain attractive is the presence of a potentially suitable repository host rock known as tuff; tuff is a highly sorptive rock composed of solidified and welded volcanic ash and detritus (rock fragments and other loose material). Tuff has good physical, mechanical, and chemical characteristics for nuclear waste containment and for preventing waste from reaching the biosphere. Each layer of tuff was formed separately millions of years ago by volcanic activity. Yucca Mountain also has an extremely deep static water table - more than 1700 feet below land surface. This feature makes it possible to choose the most favorable repository horizon in the unsaturated zone where water would not be expected to fill a repository because of very low water infiltration rates. The horizon selected for detailed at-depth characterization is a unit of the Topopah Spring tuff about 1200 feet below land surface and about 550 feet above the static water table.

258 **(ONWI—9(83-1)) Technical progress report for the quarter 1 October-31 December 1982.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1982. Contract AC06-76RL01830;AC02-83CH10140. 125p. NTIS, PC A06/MF A01. Order Number DE84001687.

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This report describes the technical accomplishments during the period from October through December 1982 on the commercial nuclear waste management programs under the direction of the Office of Nuclear Waste Isolation (ONWI). The ONWI program is organized into eight tasks: systems, waste package, site, repository, regulatory and institutional, test facilities and excavations, land, and

program management. The progress in each of these tasks is reported.

259 **(ONWI—9(83-2)) Management activities for the DOE's National Wastewater Program. Technical progress report, 1 January-31 March, 1983.** (Battelle Memorial Inst., Columbus, OH (USA)). 1983. Contract AC06-76RL01830;AC02-83CH10140. 76p. NTIS, PC A05/MF A01. Order Number DE84002556.

This report describes the technical accomplishments during the period from January through March 1983, on the commercial nuclear waste management programs under the direction of the US Department of Energy (DOE), National Waste Terminal Storage Program Office (NPO), Office of Nuclear Waste Isolation (ONWI). The scope of the National Waste Terminal Storage (NWTS) repository development effort includes comprehensive geologic exploration, technology development, equipment testing, and model verification activities, as well as the design, licensing, construction, operation, and decommissioning activities required to provide geologic repositories and spent fuel handling and packaging facilities. The ONWI program is organized into eight tasks, each one being a level-two element of the ONWI Contract Work Breakdown Structure (CWBS). These tasks are: systems, waste package, site, repository, regulatory and institutional, test facilities and excavations, land, and program management. This quarterly report reviews progress in each of these tasks.

260 **(ONWI—190(5)) Avery Island heater tests: measured data for 1000 days of heating.** Van Sambeek, L.L.; Stickney, R.G.; DeJong, K.B. (RE/SPEC, Inc., Rapid City, SD (USA)). Oct 1983. Contract AC06-76RL01830;AC02-83CH10140. 132p. NTIS, PC A07/MF A01. Order Number DE84002557.

Three heater tests were conducted in the Avery Island salt mine. The measurements of temperature and displacement, and the calculation of stress in the vicinity of each heater are of primary importance in the understanding of the thermal and thermomechanical response of the salt to an emplaced heat source. This report presents the temperature, displacement, and calculated stress data gathered during the heating phase of the three heater tests. The data presented have application in the ongoing studies of the response of geologicic media to an emplaced heat source. Specifically, electric heaters, which simulate canisters of heat-generating nuclear waste, were placed in the floor of the Avery Island salt mine, and measurements were made of the response of the salt caused by the heating. The purpose of this report is to transmit the data to the scientific community; rigorous analysis and interpretation of the data are considered beyond the scope of this data report. 11 references, 46 figures.

261 **(ONWI—485) Stratigraphy, structure, and lithofacies relationships of Devonian through Permian sedimentary rocks: Paradox Basin and adjacent areas - southeastern Utah. Technical report.** McCleary, J.; Rogers, T.; Ely, R. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Aug 1983. Contract AC06-76RL01830;AC02-83CH10140. 149p. NTIS, PC A07/MF A01. Order Number DE84002739.

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Geophysical well log analysis, literature review, and field work were conducted to develop isopach, structure contour, outcrop, and facies maps and cross sections for the Devonian through Permian strata of a 14,586-km^2 (5632-square-mile) area in southeastern Utah. The study area includes part of the Paradox Basin, the salt deposits of which are of interest in siting studies for a nuclear waste repository. For this reason hydrologic models of this area are needed. This study, part of which included the development of a three-dimensional stratigraphic computer model utilizing Geographic Information System software, can serve as a base for hydrologic or other models for this area. Within and adjacent to the study area, 730 wells were screened to select the 191 wells analyzed for the study. It was found that the Elbert through Molas formations did not exhibit noticeable facies changes within the study area. The Pinkerton Trail Formation exhibits moderate changes: anhydrite and shale become somewhat more abundant toward the northeast. Facies changes in the Paradox Formation are more dramatic. Thick saline facies deposits are present in the northeast, grading to thinner anhydrite and then to carbonate facies in the south and west. The lithology of the Honaker Trail Formation appears to be fairly uniform throughout the area. Facies changes in the Cutler Group are numerous and sometimes dramatic, and generally correspond to the named formations of the group. Other factors that could affect groundwater flow, such as stratigraphic cover of fine-grained rocks, area of formation outcrops, and fracturing and faulting are discussed and delineated on maps.

262 **(ONWI—495) Application of integral methods to prediction of heat transfer from a nuclear waste repository.** Blesch, C.J.; Kulacki, F.A.; Christensen, R.N. (Ohio State Univ. Research Foundation, Columbus (USA)). Oct 1983. Contract AC06-76RL01830;AC02-83CH10140. 109p. NTIS, PC A06/MF A01. Order Number DE84001914.

Integral methods have been developed and applied to the prediction of the far field thermal impact of a nuclear waste repository. Specifically, the heat balance integral has been applied to a semi-infinite layered domain in which a limited number of sublayers form the repository overburden, and the repository is represented by an infinite plane beneath either one or two sublayers. Calculations for PWR spent fuel with an initial areal thermal loading of 60 kW/acre are carried out for various stratigraphies and overburden compositions. Results of the analyses are temperature distributions and heat fluxes to the surface as a function to time. Based on this study, the thermophysical properties of the individual layers are identified as the most important influence on temperature distributions and maximum temperature rise at any position above the repository. The thicknesses of the sublayers play a secondary role for a given rock composition. Where a comparison to exact or numerical solutions is possible, the method predicts maximum temperature increases in the overburden to within 10 percent. Heat fluxes to the surface are found to be relatively insensitive to overburden composition. For dome salt, a maximum of 1.2 percent to 2.7 percent of the initial areal thermal power of a five-term source reaches the surface. For bedded salt, a maximum of 1 percent to 1.8 percent of the initial areal thermal power reaches the surface over a wide range of sublayer compositions. Similarly, low percentages of initial areal thermal power reach the surface for the other stratigraphies considered in the calculations.

263 **(ONWI—501) Methodology for predicting the life of waste-package materials, and components using multifactor accelerated life tests.** Thomas, R.E.; Cote, R.W. (Battelle Columbus Labs., OH (USA)). Sep 1983. Contract AC06-76RL01830;AC02-83CH10140. 92p. NTIS, PC A05/MF A01. Order Number DE84001144.

Accelerated life tests are essential for estimating the service life of waste-package materials and components. A recommended methodology for generating accelerated life tests is described in this report. The objective of the methodology is to define an accelerated life test program that is scientifically and statistically defensible. The methodology is carried out using a select team of scientists and usually requires 4 to 12 man-months of effort. Specific agendas for the successive meetings of the team are included in the report for use by the team manager. The agendas include assignments for the team scientists and a different set of assignments for the team statistician. The report also includes descriptions of factorial tables, hierarchical trees, and associated mathematical models that are proposed as technical tools to guide the efforts of the design team.

264 **(ORNL/TM—8839) Chemical, geological, and hydrological factors governing radionuclide migration from a formerly used seepage trench: a field study. Environmental Sciences Division publication No. 2202.** Olsen, C.R.; Lowry, P.D.; Lee, S.Y.; Larsen, I.L.; Cutshall, N.H. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 112p. NTIS, PC A06/MF A01. Order Number DE84001688.

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A total of 3.2 x 10^7 L of intermediate-level liquid wastes (ILW) generated from routine Oak Ridge National Laboratory operations, were disposed in Trench 7 between 1962 and 1966. The disposed ILW contained about 10^7 GBq of fission nuclides (primar-

ily ^{137}Cs and ^{90}Sr), activation products (primarily ^{60}Co), actinides (primarily ^{232}Th and ^{238}U decay series nuclides), and transuranics (primarily ^{241}Pu-^{241}Am). Gamma-log profiles of the wells near ILW Trench 7 indicate that the waste liquids seeped along discrete layers parallel to bedding and along the strikes of faults and folds. Although most of the radioactivity has been retained by sorption reactions with the trench fill, soils, and weathered bedrock, groundwater characteristics in the vicinity of ILW Trench 7 are still greatly influenced by the constituents of the waste liquids disposed two decades ago. Radionuclide concentrations in the groundwaters near the north end of ILW Trench 7 undergo seasonal variations, with the lowest activities occurring in fall and winter and the highest activities occurring in the spring and after prolonged rainstorm events. The rise in radioactivity in these wells correlates with a rise in the groundwater level and a concurrent increase in groundwater pH. Although ILW Trench 7 has worked effectively to retain most of the disposed radioactivity, two suspected transport pathways from the trench to a nearby seep area have been identified and both appear to be associated with fault zones. Only the pathway near the north end of the trench appears to be leaching alkalinity and thus affecting the retention capacity for ^{90}Sr. A groundwater interceptor at the north end of ILW Trench 7 is one possible remedial action to help maintain a dry alkaline environment and ensure the integrity of the trench for nuclide retention.

265 **(PNL—4754) Review and evaluation of metallic TRU nuclear waste consolidation methods.** Montgomery, D.R.; Nesbitt, J.F. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1983. Contract AC06-76RL01830. 185p. NTIS, PC A09/MF A01. Order Number DE84001919.

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The US Department of Energy established the Commercial Waste Treatment Program to develop, demonstrate, and deploy waste treatment technology. In this report, viable methods are identified that could consolidate the volume of metallic wastes generated in a fuel reprocessing facility. The purpose of this study is to identify, evaluate, and rate processes that have been or could be used to reduce the volume of contaminated/irradiated metallic waste streams and to produce an acceptable waste form in a safe and cost-effective process. A technical comparative evaluation of various consolidation processes was conducted, and these processes were rated as to the feasibility and cost of producing a viable product from a remotely operated radioactive process facility. Out of the wide variety of melting concepts and consolidation systems that might be applicable for consolidating metallic nuclear wastes, the following processes were selected for evaluation: inductoslay melting, rotating nonconsumable electrode melting, plasma arc melting, electroslag melting with two nonconsumable electrodes, vacuum coreless induction melting, and cold compaction. Each process was evaluated and rated on the criteria of complexity of process, state and type of development required, safety, process requirements, and facility requirements. It was concluded that the vacuum coreless induction melting process is the most viable process to consolidate nuclear metallic wastes. 11 references.

266 **(PNL—4834) Savannah River Plant defense waste vitrification studies during FY 1982. Summary report.** Ethridge, L.J. (comp.). (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 104p. NTIS, PC A06/MF A01. Order Number DE84002372.

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Five major melter runs were completed during FY 1982 on the Pilot-Scale Ceramic Melter (PSCM). Over 41,000 L of feed were processed by the PSCM, producing ~ 21,000 kg of glass. The design basis reference capacity of ~ 39 kg/h-m^2 was met or exceeded in all the melter runs. Off-gas characterization was emphasized during this fiscal year. Entrainment of feed material is the largest contributor to the mass of particulate leaving the melter, averaging 0.2 wt% of the incoming feed on an oxide basis. This is a DF of ~ 500. This mass does show an enrichment of some of the volatile and semivolatile components. Higher losses of cesium, tellurium, and cadmium occurred with formate feed. The Experimental Ceramic Melter (ECM) was used this year to study the application of two techniques to increase melting rates in ceramic melters. The first was the use of an air sparger to forcibly agitate the glass in the melter to improve the heat transfer. The air-sparger agitation increased the throughput capacity of the ECM, but did not seem to affect melting efficiency. The second technique for increasing melter rates tested on the ECM was the use of microwave boosting. While significant improvement was noted in the vitrification rates, two problems were encountered: coating of the isolation window and heating of the refractory lining of the ECM lid. The buildup of fine dust on the window caused arcing between the coating and the waveguide. This arcing damages the window and waveguide and causes instability in the microwave power supply. Four techniques were investigated to solve the problem. These techniques were of limited success and await further testing. 33 figures, 58 tables.

267 **(PNL—4848) Instrumentation and assay procedures for verification of the radionuclide content of low-level waste packages.** Brodzinski, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 18p. NTIS, PC A02/MF A01. Order Number DE84001664.

The preferred embodiment of waste package assay instrumentation for verification of the radionuclide content is a high resolution germanium diode gamma-ray spectrometer incorporated in a segmented gamma scanner and a passive neutron interrogation system for measurement of the neutrons emitted spontaneously from a waste package. The selection criteria and rationale for this choice are discussed. Assembly and operation procedures for the instrumentation are recommended, and methods for data acquisition and reduction are given. The choice of radioisotopes for fabrication of calibration standards is ^{60}Co at ~ 10 mCi/m^3, ^{90}Sr at ~ 10 mCi/m^3, ^{134}Cs at ~ 14 mCi/m^3, ^{137}Cs at ~ 15 mCi/m^3, and transuranic alpha activity at ~ 10 nCi/g. Suggested matrix materials are given.

268 **(PNL-SA—11416) PNL size reduction and decontamination facilities and capabilities.** Allen, R.P.; Fetrow, L.K.; McCoy, M.W. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1983. Contract AC06-76RL01830. 25p. (CONF-830650—4). NTIS, PC A02/MF A01. Order Number DE84002592.

From FRG/US workshop on size reduction and decontamination facilities; Karlsruhe, F.R. Germany (27 Jun 1983).

Studies sponsored by the US Department of Energy at Pacific Northwest Laboratory (PNL) have resulted in the development of an effective, integrated size reduction and decontamination system for transuranically contaminated components. Using this system, a reduction of more than 95% in the volume of transuranic waste requiring interim storage and eventual geologic disposal has been achieved for typical plutonium contaminated glove boxes. This paper describes the separate preparation, size reduction, decontamination and waste treatment operations and facilities that have been developed and demonstrated as part of this work.

269 **(RHO-BW-SA—298A-P) Status of geologic and hydrologic characterization of a potential nuclear waste repository site in basalt.** Price, S.M.; Gephart, R.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1983. Contract AC06-77RL01030. 4p. (CONF-8310192—1). NTIS, PC A02/MF A01. Order Number DE84001113.

From Geological Society of America annual meeting; Indianapolis, IN, USA (31 Oct 1983).

Within the Basalt Waste Isolation Project, geohydrologic studies are focusing on repository site characterization, particularly those factors that might influence groundwater transport of radionuclides to the accessible environment. Beneath the Hanford Site, the Columbia River basalt consists of at least 70 basalt flows extending to a depth of >3 km. Within the 180-km^2 central Cold Creek syncline, these flows appear to be nearly flat lying; at least four are thick (>40 m) and laterally continuous and are presently considered potential candidates for repository development. These flows lie 850 to 1150 m below ground level within a 47-km^2 area currently considered to be the prime candidate site. Tectonic studies appear to indicate that the site area was deforming at a low average rate of strain in the Miocene and that this rate has continued into the late Cenozoic. Available head and hydrologic data

appear to indicate that groundwater within the deeper basalts generally moves laterally through zones of higher hydraulic conductivity (flow tops) and vertically through the fractured flow interiors. Hydraulic head gradients appear to be low ($\sim 10^{-4}$ m/m). Horizontal hydraulic conductivity values of 10^{-11} to 10^{-14} m/s have been measured within flow interiors; tests needed to obtain vertical hydraulic conductivity values are planned. An iterative approach involving numerical modeling and data collection and interpretation is being used to develop a preliminary geohydrologic conceptual model of the potential site and surrounding area.

270 **(RHO-PB-SR—10-B-WM-Sept.-83) Rockwell Hanford Operations defense waste and byproducts management monthly report.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1983. Contract AC06-77RL01030. 109p. NTIS, PC A06/MF A01. Order Number DE84002697.

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Scheduled saltwell jet pumping in TX and TY Tank Farms was completed in FY 1983, and 18 single-shell tanks in these farms were declared interim-stabilized, surpassing the fiscal year milestone of 2 stabilized tanks by 16 tanks. Isolation Projects B-145 and B-181 were completed, and effort in Isolation Projects B-222 and B-231 was initiated. A total of twenty-three single-shell tanks were declared interim-isolated, which exceeds the fiscal year milestone of 15 stabilized tanks by 8 tanks. The milestone for completing 125 strontium capsules was met July 30, two months ahead of schedule. Nine strontium capsules were completed in September for a record total of 150 strontium capsules in FY 1983. A total of 172 acres of outdoor radiation areas, including trenches, inactive burial grounds, small contaminated surface areas, and the Gable Mountain Pond peripheral area was surface stabilized. Seeding and mulching of the stabilized areas will be completed during the first quarter of FY 1984. Waste Management facilities were certified as ready to receive PUREX Waste. A total of 818,210 gallons was jet pumped from the TX, TY and BY Tank Farms versus a production goal of 800,000. The milestone for completing encapsulation of the cesium backlog stored in B Plant was met during fiscal year 1983. In September 38 cesium capsules were produced as a result of the yield from cesium process equipment clean up. A total of 176 capsules were produced during the fiscal year. A total of 6.3 MCi of strontium feed was purified in FY 1983. A total of 1.3 MCi of cesium was purified in September for a fiscal year-to-date total of 20.7 MCi. The planned FY 1983 evaporator campaign was completed in February. Total evaporator throughput was approximately 9.6 million gallons with a waste volume reduction of about 3.5 million gallons.

271 **(SAND—83-1387) Subseabed Disposal Program: 1983 status report.** (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 170p. NTIS, PC A08/MF A01. Order Number DE84001916.

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This document presents the status to date of the US Subseabed disposal program. It describes the Program's accomplishments since its beginning in 1974 and identifies required future research and development. Each program area is described, with additional references provided at the end of each section, including the annual and topical reports on the Subseabed Disposal Program that have been issued each year.

272 **(UCRL—89404) Selection of barrier metals for a waste package in tuff.** Russell, E.W.; McCright, R.D.; O'Neal, W.C. (Lawrence Livermore National Lab., CA (USA)). Sep 1983. Contract W-7405-ENG-48. 11p. (CONF-831174—3). NTIS, PC A02/MF A01. Order Number DE83018182.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

The Nevada Nuclear Waste Storage Investigation (NNWSI) project under the Civilian Radioactive Waste Management Program is planning a repository at Yucca Mountain at the Nevada Test Site for isolation of high-level nuclear waste. LLNL is developing designs for an engineered barrier system containing several barriers such as the waste form, a canister and/or an overpack, packing, and near field host rock. The selection of metal containment barriers is addressed. 13 references.

273 **(UCID—18509-82-3-4-83-1-2) Development of advanced technologies for photochemical tritium recovery. Tetraquarterly progress report, July 1, 1982-June 30, 1983.** Aldridge, F.T.; Herman, I.P.; Magnotta, F.; Maienschein, J.L. (Lawrence Livermore National Lab., CA (USA)). 15 Aug 1983. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01. Order Number DE84002706.

The experimental investigations of the 12μ laser phtochemistry of $CTCl_3/CDCl_3$ mixtures and the $CdCl_2$/DTO hydrogen exchange rate are described. Details of the overall process for tritium-from-deuterium recovery by multiple-photon dissociation of chloroform are also presented.

274 **Radiation effects in silicate glasses pertinent to their application as a radioactive waste storage medium.** Primak, W. (Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, Illinois 60439). *Nuclear Technology;* 60: No. 2, 199-205(Feb 1983).

A variety of radiation effects are delineated in complex silicate glasses: formation of centers, expansion, two kinds of contraction, surface alkali activation, and enhanced leaching. The intense energy deposition in the last fraction of the ranges of the actinide recoils appears to produce other effects than those from the diffuse energy deposition associated with the light ions and with ionization. Although there are other serious gaps in our knowledge of the radiation behavior of these materials, and the data available are rather limited, the most serious deficiency for waste management is the lack of adequate temporal and thermal data.

275 **Thermoluminescence for self-dosimetry in Climax Stock quartz monzonite.** Carlson, R.C. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Nuclear Technology;* 60: No. 2, 244-252(Feb 1983).

An examination has been made of the feasibility of using thermoluminescence (TL) for the selfdosimetry of the rock surrounding a canister of nuclear waste. The rock investigated was quartz monzonite from the Climax Stock, a granite intrusive at the Nevada Test Site. Samples of the rock were irradiated by ^{60}Co to doses of 10^3 to 10^9 rads, then ground to a fine powder and read for TL response at a heating rate of 1°C/s. The procedures are described in detail to allow their duplication by others. Effects of total dose, thermal history after irradiation, grinding to a powder after irradiation, mineral composition, and powder grain size were investigated. Although all of these factors were found to be important, the use of TL in this manner appears promising.

276 **Fusion of acid oxides for potentially radiation-resistant waste forms.** Herrick, C.C.; Penneman, R.A. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Nuclear Technology;* 60: No. 2, 253-256(Feb 1983).

Skull melting of groups VA and VB acid oxides with alkali metal oxides and urania leads to compounds with a good ability to retain radionuclides and establishes immunity to radiation damage. Substitution of neptunium and plutonium for uranium should not diminish these desirable properties. For hexavalent transplutonic elements, even at high oxygen fugacities and oxide activities, acid character losses and the reducing nature of radiation suggest the lower valences (III and IV) will be the stable states. Plutonium becomes the pivotal radionuclide when valence stability in a radiation field is considered.

277 **Radiation effects in solution and on the solid/liquid interface.** Nash, K.L.; Fried, S.; Friedman, A.M.; Rickert, P.; Sullivan, J.C.; Susak, N. (Argonne National Laboratory, Chemistry Division, 9700 South Cass Avenue, Argonne, Illinois 60439). *Nuclear Technology;* 60: No. 2, 257-266(Feb 1983).

The rates at which ^{241}Am and ^{239}Pu are leached by triply distilled water from a candidate borosilicate glass 76-101 can be adequately correlated by the exponential, An = An_0 /SUP -kt/ ,

where An is the concentration of the actinide in molar mass per square centimetre. The values for the parameters An_0 and k are 2.45 X 10^{-9} M/cm² and 0.024 + or - 0.001 h^{-1}, respectively, over the period of 1 to 24 h. When the glass samples are irradiated with gamma rays from a ^{60}Co source of 1 Mrad/h, values of the parameters (1to 24-h irradiation time) are A_0 = 5.6 C 10 $^{-9}$ M/cm², k = 0.103 + or - 0.004 h^{-1} for ^{239}Pu and A_0 " 2.2 X 10^{-11} M/cm², k = 0.104 + or - 0.003 h^{-1} for ^{241}Am.

278 **Radiation effects and their relationship to geological repositories.** Lam, D.J. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). *Nuclear Technology;* **60**: No. 2, 267(Feb 1983).

This article provides a summary of discussions and recommendations that were made by panelists at the Argonne National Laboratory Specialists' Workshop on Basic Research Needs for Nuclear Waste Management. The topics covered can be divided into 3 categories: radiation effects on the solid waste forms, radiolysis of leaching solution, and radiation effects on canister, backfill, and geostrata materials. Indicates that the following areas in the radiation effect on waste form leaching should be investigated: studies of the effects of sample composition and preparation techniques on the leaching rate under radiation; studies of the "Dran effect" on leaching; studies of the mechanism resulting in expansion of glasses under irradiation; studies of the structural property changes under external and internal radiation conditions; and studies of the effects of transmutation on the stability and leachability of waste forms.

279 **A review of radiation effects in solid nuclear waste forms.** Weber, W.J.; Roberts, F.P. (Pacific Northwest Laboratory, P.O. Box 999, Richland, Washington 99352). *Nuclear Technology;* **60**: No. 2, 178-198(Feb 1983).

The major source of radiation effects in solid nuclear waste forms is from the alpha decay of the actinide elements. These radiation effects have generally been investigated by doping simulated waste forms with short-lived actinides. Although measurable changes in volume, stored energy, and microstructure occur, no significant changes in leach rate or mechanical properties are observed. The changes in volume and stored energy of solid nuclear waste forms follow an exponential dependence on dose, exhibiting saturation effects at a dose of about 5 X 10^{24} alpha decay/m³.

280 **Radiation effects in SYNROC-D.** Konynfnburg, R.A.; Guinan, M.W. (University of California, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Nuclear Technology;* **60**: No. 2, 206-217(Feb 1983).

SYNROC-D is a ceramic material proposed as a waste form for defense high-level nuclear waste. During the first million years of storage, it would be subjected to about8 X 10^{24} alpha decay/m³ of SYNROC-D and a total ionization dose of about1 X 10^{11} rad. There are several methods of simulating the resulting radiation effects, including external bombardment using gamma rays, electrons, light ions, heavy ions, or neutrons, and internal bombardment using short half-life actinide doping to bring about internal alpha decay, or doping with uranium, boron, or lithium, coupled with neutron irradiation, to induce internal fissions or (n.α) reactions. The results show that dose rate effects are not important in determining the swelling and metamictization of the perovskite and zirconolite phases over a wide range of dose rate for low temperatures and doses of 2 to 3 X 10^{25} alpha/m³ of each phase, corresponding to expected million year doses in SYNROC-D. Based on this observation and a consideration of the basic processes involved, the authors argue that the million-year radiation damage expected in SYNROC-D can be adequately simulated in a few months by doping samples with ^{238}Pu, and simultaneously carrying out external gamma-ray bombardment. The ^{238}Pu will undergo alpha decay, producing the same type of damage in the same phases as would long-term actinide decay in actual waste. The gamma irradiation will simulate the ionization dose, which would result primarily from fission product decay in actual waste. SYNROC-D samples have been fabricated and characterized using cerium and uranium, respectively, as stand-ins for plutonium. These samples show good properties, and ^{239}Pu doping experiments are expected to take place soon to determine if plutonium will dissolve properly in SYNROC-D.

281 **Limiting-individual dose from an extended-source high-level waste repository model.** Edwards, L.L.; Harvey, T.F. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Nuclear Technology;* **60**: No. 1, 84-96(Jan 1983).

This paper focuses on the effects of mine design features on postclosure risk associated with a nuclear waste repository. Under conditions that enhance the effects of mine features and where the waste package allows high release rates, it was found that point-source repository models can lead to a range of "limiting-individual" doses covering several orders of magnitude. If engineered features are included in the models, these predicted doses are substantially lower.

282 **Migration of concentrated radionuclide solutions in water-saturated soil investigation of a hypothetical high activity waste solution discharge accident.** Schwarzer, K.; Katscher, W.; Thelen, J. (Kernforschungsanlage Julich, GmbH Institut fur Nukleare Sicherheitsforschung, Postfach 1913, D-517 Julich 1). *Nuclear Technology;* **60**: No. 1, 97-103(Jan 1983).

For the case of postulated leakage from a tank containing a high activity nuclear waste solution, as planned for the German reprocessing plant at Gorleben, the migration of radionuclides in the groundwater current has been examined. As the nuclide migration velocity is strongly influenced by sorption processes, which for a given soil are concentration dependent, adsorption and desorption coefficients for strontium, cesium, ruthenium, and cerium were measured over a wide concentration range in sandy subsoil taken from the Gorleben site. Using the results from the adsorption experiments and neglecting the fact that the sorption coefficients in the case of desorption turn out to be significantly higher, migration velocities and concentration profiles for strontium, cesium, ruthenium, and cerium were calculated with the MOFIS code. The results show significant delay and concentration decrease of the radionuclides with strontium being the "critical" element.

283 **Conflicting views on a neutrality criterion for radioactive-waste management.** Cochran, T.B. (Natural Resources Defense Council, Washington, DC); Bodde, D.L. pp 110-128 of Energy and the future. MacLean, D.; Brown, P.G. (eds.). Totowa, NJ; Rowman and Littlefield (1983).

Two essays are presented by authors who agree that risks imposed on future generations through the management of radioactive waste are acceptable if they meet a criterion of neutrality, but who disagree on the interpretation of the neutrality criterion. The first viewpoint argues that acceptable isolation of high-level radioactive waste is yet to be accomplished and that a fundamental criterion for radioactive waste disposal must include consideration of the intergenerational radiation effects. The second essay promotes balanced resource allocation, technological progress, and adequate problem-solving institutions as the solution to the problem. The debate illustrates the complexities involved in applying philosophical principles to public policy, even when the principles have been agreed upon. 23 references, 1 figure.

284 **Performance test of the shaft Konrad for ultimate storage of radioactive wastes. Vol. 2.** Neuherberg, Germany, F.R.; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. ([nd]). 423p. (In German). (GSF-T—136(Bd.2)). Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Muenchen, Neuherberg, Germany, F.R.

Besides a detailed description of the iron mine, model calculations are carried out for an uncontrolled water ingress in the ultimate storage. In such a case a contamination is restricted to the immediate surroundings of the ultimate storage site if the conditions mentioned here are observed. In the post-operational stage a hypothetic filling of the remaining caverns in storage chambers with saline depth water need therefore not be considered as an accident. A contamination of usable reserves of ground water seems impossible.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 251, 259, 264, 281, 282, 886, 1230, 1231, 1232, 1250, 1260, 1263, 1273

285 **(DPST—83-737) Adult fisheries studies in the Savannah River. Interim report, September 1982-February 1983.** O'Hara, J.; Osteen, V. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Jun 1983. Contract AC09-76SR00001. 59p. NTIS, PC A04/MF A01. Order Number DE84001042.

The study examines the fish community of the Savannah River and its relationship to the Savannah River Plant. This portion of the ongoing study examined the occurrence, relative abundance and distribution of adult fishes in the Savannah River, intake canals and the mouths of three onsite creeks during October 1982 and January 1983. The study also examined the impingement of fishes on the cooling water intake screens of the Savannah River Plant. Population estimates of select species were made when sufficient data were available from a mark and recapture program. 22 references, 1 figure, 13 tables.

286 **(PNL—4608-3) Uranium recovery research sponsored by the Nuclear Regulatory Commission at Pacific Northwest Laboratory. Annual progress report, May 1982-May 1983.** Foley, M.G.; Opitz, B.E.; Deutsch, W.J.; Peterson, S.R.; Gee, G.W.; Serne, R.J.; Hartley, J.N.; Thomas, V.W.; Kalkwarf, D.R.; Walters, W.H. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1983. Contract AC06-76RL01830. 104p. NTIS, PC A06/MF A01. Order Number DE84002629.

Pacific Northwest Laboratory (PNL) is currently conducting research for the US Nuclear Regulatory Commission (NRC) on uranium recovery process wastes for both active and inactive operations. NRC-sponsored uranium recovery research at PNL is focused on NRC regulatory responsibilities for uranium-recovery operations: license active milling and in situ extraction operations; concur on the acceptability of DOE remedial-action plans for inactive sites; and license DOE to maintain inactive sites following remedial actions. PNL's program consists of four coordinated projects comprised of a program management task and nine research tasks that address the critical technical and safety issues for uranium recovery. Specifically, the projects endeavor to find and evaluate methods to: prevent erosion of tailings piles and prevent radon release from tailings piles; evaluate the effectiveness of interim stabilization techniques to prevent wind erosion and transport of dry tailings from active piles; estimate the dewatering and consolidation behavior of slurried tailings to promote early cover placement; design a cover-protection system to prevent erosion of the cover by expected environmental stresses; reduce seepage into ground water and prevent ground-water degradation; control solution movement and reaction with ground water in in-situ extraction operations; evaluate natural and induced restoration of ground water in in-situ extraction operations; and monitor releases to the environment from uranium recovery facilities.

287 **(PNL-SA—10836) Importance of actinide solubility and speciation in nuclear waste repository assessment.** Strickert, R.G. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1983. Contract AC06-76RL01830. 24p. (CONF-821053—6). NTIS, PC A02/MF A01. Order Number DE84002591.

From Workshop on standardization of methods for measuring migration of radionuclides in geomedia; Berlin, F.R. Germany (25 Oct 1982).

Radioactive wastes disposed in geologic repositories could present an environmental hazard if their toxic elements were released to the biosphere via groundwater pathways. To determine the maximum radionuclide concentration that could reach the biosphere, one must determine the highest initial concentration and chemical forms of each radionuclide based on its solubility limits and aqueous speciation. As the radionuclide moves through geologic materials, precipitation/dissolution and adsorption/desorption reactions may further reduce contaminant concentrations and/or impede migration relative to groundwater movement. The determination of solubility control limits is appropriate for several long-lived actinidies which are present in nuclear wastes and which form compounds which may be relatively insoluble under various groundwater conditions. Current US repository licensing requirements (1) limit the release rate of radioactive waste after an initial containment period (300 to 1000 years). The short-lived fission products will have largely decayed during the containment period, leaving a few long-lived fission products, activation products, and the actinides. It is the release rates of these radionuclides which must be addressed in the repository safety assessment needed for licensing. 20 references, 12 figures.

288 **(PNL-SA—11576) Evaluating biological transport of radionuclides at low-level waste burial sites.** Cadwell, L.L.; Kennedy, W.E.; McKenzie, D.H. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1983. Contract AC06-76RL01830. 17p. (CONF-8308106—18). NTIS, PC A02/MF A01. Order Number DE84000680.

From 5. annual participants information meeting of DOE low level waste management program; Denver, CO, USA (30 Aug 1983).

The purpose of the work reported here is to develop and demonstrate methods for evaluating the long-term impact of biological processes at low-level waste (LLW) disposal sites. As part of this effort, we developed order-of-magnitude estimates of dose-to-man resulting from animal burrowing activity and plant translocation of radionuclides. Reference low-level waste sites in both arid and humid areas of the United States were examined. The results of our evaluation for generalized arid LLW burial site are presented here. Dose-to-man estimates resulting from biotic transport are compared with doses calculated from human intrusion exposure scenarios. Dose-to-man estimates, as a result of biotic transport, are of the same order of magnitude as those resulting from a more commonly evaluated human intrusion scenario. The reported lack of potential importance of biotic transport at LLW sites in earlier assessment studies is not confirmed by our findings. These results indicate that biotic transport has the long-term potential to mobilize radionuclides. Therefore, biotic transport should be carefully evaluated during burial site assessment.

0540 Health And Safety

REFER ALSO TO CITATION(S) 123, 199, 231, 244, 245, 255, 281, 288, 531, 1359

289 **(DOE/EV—0005/44) Post remedial action survey report for Building 003, Santa Susana Field Laboratories, Rockwell International, Ventura County, California, October 1981; April 1982. Surplus Facilities Management Program.** Wynveen, R.A.; Smith, W.H.; Sholeen, C.M.; Justus, A.L.; Flynn, K.F. (Argonne National Lab., IL (USA)). Oct 1983. Contract W-31-109-ENG-38. 70p. (ANL-OHS/HP—83-109). NTIS, PC A04/MF A01. Order Number DE84002441.

Rockwell International's Santa Susana Laboratories in Ventura County, California, have been the site of numerous Federally-funded projects involving the use of radioactive materials. One such project was the System for Nuclear Auxiliary Power (SNAP) Program. Building 003 on the Santa Susana site was used in conjunction with the SNAP Program and contained a highly shielded area designed for remote manipulation of radioactive materials. Such facilities are commonly referred to as hot caves. During the SNAP Program, fuel burnup samples were analyzed and irradiation experiments were evaluated in the Building 003 hot cave. Use of the hot cave facility ended when the SNAP Program was terminated in 1973. Subsequently, the Building 003 facilities were declared excess and were decontaminaed and decommissioned during the first half of calendar year 1975. At that time, the building was given a preliminary release. In 1981, a post-remedial-action (certification) survey of Building 003 was conducted at the request of the Department of Energy. Significant levels of residual contamination were found in various parts of the building. Consequently, additional decontamination was conducted by Rockwell International. A final post-remedial-action survey was conducted during April 1982, and those areas in Building 003 that had been found contaminated in 1981 were now found to be free of detectable radioactive contamination. Sludge samples taken from the sewer sump showed ele-

vated levels of enriched uranium contaminant. Hence, all sewer lines within Building 003 were removed. This permitted unconditional release of the building for unrestricted use. However, the sewer lines exterior to the building, which remain in place, must be considered potentially contaminated and, therefore, subject to restricted use.

290 **(DOE/EV—0005/45) Post-remedial-action survey report for Kinetic Experiment Water Boiler Reactor Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California.** Wynveen, R.A.; Smith, W.H.; Sholeen, C.M.; Flynn, K.F.; Justus, A.L. (Argonne National Lab., IL (USA)). Oct 1981. Contract W-31-109-ENG-38. 68p. (ANL-OHS/HP—83-110). NTIS, PC A04/MF A01. Order Number DE84002442.

Rockwell International's Santa Susana Laboratories in Ventura County, California, have been the site of numerous federally-funded contracted projects involving the use of radioactive materials. Among these was the Kinetics Experiment Water Boiler (KEWB) Reactor which was operated under the auspices of the US Atomic Energy Commission (AEC). The KEWB Reactor was last operated in 1966. The facility was subsequently declared excess and decontamination and decommissioning operations were conducted during the first half of calendar year 1975. The facility was completely dismantled and the site graded to blend with the surrounding terrain. During October 1981, a post-remedial-action (certification) survey of the KEWB site was conducted on the behalf of the US Department of Energy by the Radiological Survey Group (RSG) of the Occupational Health and Safety Division's Health Physics Section (OHS/HP) of Argonne National Laboratory (ANL). The survey confirmed that the site was free from contamination and could be released for unrestricted use.

291 **(ORNL/EIS—154/Vol.4) Nuclear facility decommissioning and site remedial actions: a selected bibliography. Volume 4.** Owen, P.T.; Knox, N.P.; Fielden, J.M.; Faust, R.A. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 595p. (RLO/SFM—80/5/Vol.4). NTIS, PC A25/MF A01. Order Number DE84001209.

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This bibliography of 657 references with abstracts on the subject of nuclear facility decommissioning, uranium mill tailings management, and site remedial actions is the fourth in a series of annual reports prepared for the US Department of Energy, Division of Remedial Action Projects. Foreign as well as domestic documents of all types - technical reports, progress reports, journal articles, conference papers, symposium proceedings, theses, books, patents, legislation, and research project descriptions - have been references in this publication. The bibliography contains scientific (basic research as well as applied technology), economic, regulatory, and legal literature pertinent to the US Department of Energy's Remedial Action Program. Major chapters are: (1) Surplus Facilities Management Program; (2) Nuclear Facilities Decommissioning; (3) Formerly Utilized Sites Remedial Action Program; (4) Uranium Mill Tailings Remedial Action Program; (5) Grand Junction Remedial Action Program; and (6) Uranium Mill Tailings Management. Chapter sections for chapters 1 and 2 include: Design, Planning, and Regulations; Site Surveys; Decontamination Studies; Dismantlement and Demolition; Land Decontamination and Reclamation; Waste Disposal; and General studies. The references within each chapter or section are arranged alphabetically by leading author. References having no individual author are arranged by corporate author, or by title. Indexes are provided for the categories of author, corporate affiliation, title, publication description, geographic location, and keywords. Appendix A lists 264 bibliographic references to literature identified during this reporting period but not abstracted due to time constraints. Title and publication description indexes are given for this appendix. Appendix B defines frequently used acronyms, and Appendix C lists the recipients of this report according to their corporate affiliation.

0550 Regulations

REFER ALSO TO CITATION(S) 615

292 **(LA—9645-MS) Statistical considerations concerning multiple materials balance models.** Beedgen, R. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 67p. NTIS, PC A04/MF A01. Order Number DE84002323.

We explain how an inspector can statistically evaluate collected accounting data within a fixed time to decide if nuclear material has been diverted or not. The fixed time is divided into several accounting periods to enable an early detection of diversion. This report contains the mathematical model for a multiple balance situation. A saddle-point solution for diversion scenario and decision procedure is given only where the detection probability is the point of optimization. A sequential test based on the statistic of cumulative materials balances is presented where a truncation is made at the end of the fixed time. Some ideas are developed on how to quantify the timeliness of a decision. The theoretical considerations are illustrated with the example of a 1000 tonne/y spent-fuel model reprocessing facility. We show how powerful the considered tests are under an ideal model of a bulk-handling plant.

293 **(LA—9789-MS) In-plant experience with automated gamma-ray spectroscopy systems for plutonium isotopic composition measurements.** Sampson, T.E.; Sandford, E.L.; Bowersox, D.F.; Johnson, S.S.; Hsue, S.T.; Parker, J.L.; Kroncke, K.; Walton, G. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01. Order Number DE84002316.

Two gamma-ray spectroscopy systems for the nondestructive measurement of the isotopic composition of plutonium are described. One system is at the Savannah River Plant and the other is at the TA-55 Plutonium Facility at Los Alamos National Laboratory. Results from a year's operation of the Los Alamos system are presented. 14 figures, 15 tables.

294 **Applications of IAEA safeguards effectiveness assessment methodology.** Pasternak, T.; Rosenthal, M.D. (International Atomic Energy Agency, Vienna (Austria)); Sanborn, J.B. (Brookhaven National Lab., Upton, NY (USA)). pp 81-93 of Nuclear safeguards technology 1982. Proceedings of an international symposium on recent advances in nuclear material safeguards organized by the IAEA and held in Vienna, 8-12 November 1982. Vol. 1. Vienna, Austria; IAEA (1983). (CONF-821119—; IAEA-SM—260/133).

From International symposium on recent advances in nuclear materials safeguards; Vienna, Austria (8 Nov 1982).

For a number of years, the International Atomic Energy Agency (IAEA) has been developing a methodology for evaluating the effectiveness of international safeguards systems. In late 1981, an IAEA Advisory Group endorsed the basic principles of this safeguards effectiveness assessment methodology (SEAM), as well as its trial application to LWRs using actual inspection data and its continued development to bulk handling facilities. During this development process a number of case study applications of the methodology were also undertaken as part of the U.S. support programme to IAEA. Specifically, these case studies dealt with (a) a mixed oxide fabrication facility, (b) a reprocessing facility, and (c) a number of special cases of LWR safeguards. This paper describes experience with the application of the methodology in these studies, preliminary experience in the trial application to LWRs, and plans for possible future utilization of the methodology. A number of general lessons have been drawn from the process of applying the assessment methodology to the various types of facilities that were considered: (1) Safeguards problems differ within a facility type, so that an assessment must be made using a fairly specific set of assumptions. (2) The question of what follow-up activities would be necessary to resolve the initial anomalies discovered by the safeguards system is an important one, whose answer may determine the acceptability of the system to the Agency or the operator. (3) The number of diversion paths analysed grows rapidly with the number of combinations of concealment methods considered, and a simplified means of presentation and manipulation is important.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 218, 996

295 **(MLM—3095) Stable isotope sales: Mound customer and shipment summaries, FY 1982.** Ruwe, A.H. Jr. (comp.). (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1 Oct 1983. Contract AC04-76DP00053. 24p. NTIS, PC A02/MF A01. Order Number DE84001888.

A listing is given of Mound's sales of stable isotopes of noble gases, carbon, oxygen, nitrogen, chlorine, and sulfur for Fiscal Year 1982. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-reference index by location is included for domestic customers. Cross-reference listings by isotope purchased are included for all customers.

0703 Isotopic Power Supplies

296 **(CONF-831025—20) SIMS study of compositional changes observed in a PuO_2 heat source cladding alloy.** Christie, W.H.; Taylor, D.H.; Eby, R.E.; Pavone, D. (Oak Ridge National Lab., TN (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001936.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Secondary ion mass spectrometry (SIMS) has been used to investigate changes that occur in an advanced Ir-0.3W alloy during high temperature aging. This alloy is used to clad $^{238}PuO_2$ heat sources used in thermoelectric generators for deep space reconnaissance satellites. Long-term direct contact with PuO_2 at 1400°C leads to physical and chemical changes within the cladding alloy that affect its metallurgical properties. SIMS was used to show that Cr, Fe, Ni, and in some cases O, diffuse from the PuO_2 into the alloy. Thorium and aluminum diffuse out of the alloy in these same regions. This SIMS study suggests that inward O diffusion and subsequent formation of ThO_2 on grain boundaries may stabilize the alloy against enhanced grain growth.

08 HYDROGEN

0801 Production

297 **(LBL—16559) Fuels and chemicals from biomass depolarized water electrolysis. For the period September 28, 1981-November 30, 1982.** St. John, M.R.; Furgala, A.J. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1983. Contract AC03-76SF00098;AC02-81CE90032. 167p. (DOE/CE/90032—13). NTIS, PC A08/MF A01. Order Number DE84001847.

The program's principal objective was to identify anode depolarizers derivable from biomass sources capable of reducing the overall cell voltage for electrolytic processes, in particular hydrogen generation, by replacing the oxygen evolution reaction by the thermodynamically more favorable electro-oxidation of biomass materials. A second objective was to identify the anodic reactions of the biomass materials. Two beneficial outcomes of the biomass electroxidation were envisioned: (1) the synthesis of a desirable organic chemical from a biomass feedstock and (2) the complete electrooxidation of the biomass to CO_2, which could be used as a method of removal of unwanted or waste biomass from water. These beneficial anodic reactions would, of course, occur along with a desirable cathodic reaction such as hydrogen generation. The biomass-derivable materials selected for investigation were chosen from the two most abundant biomass materials groups, carbohydrates and lignins. In particular, glucose, its derivatives, and its polymers were considered to be representative of the carbohydrate group and were explored. Lignins selected were those derived from the two principal pulping processes, sulfite and kraft. The largest current densities for carbohydrate electrooxidation were obtained with palladium, nickel, and lead ruthenate anodes, on the order of 200 mA/cm², which makes them likely candidates for depolarizing anode materials. The short-term data suggest that cells generating hydrogen, which were carbohydrate or lignin depolarized, could operate in the range of 600 to 1100 mV. Reaction product analysis of glucose electrooxidation was carried out on platinum only and was found to be highly nonspecific. Electrooxidation of carbohydrates to carbon dioxide appeared possible on platinum and lead ruthenate anodes.

0802 Storage

298 **(EUR—8025-DE) Study of the hydrogen storage capacity of cryoadsorbers and comparison with alternative methods of hydrogen storage.** Carpetis, C.; Peschka, W. (Commission of the European Communities, Luxembourg). 1982. 129p. (In German). Available from Commission of the European Communities, Brussels (Belgium).

In the project FA 505-78-4 EHD the studies on the application of cryoadsorbers for hydrogen storage are continued, increasing the storage volume to 65 l, in order to get information on the scaling effects. Although this volume is still too small compared with the storage volume of a stationary hydrogen storage device, the results indicate a scaling law, which influences the temperature characteristics and the time constants for the equilibrium states, the storage volume, however, shows a dependency as in the case of "small samples". Thus for practical applications the dynamic behaviour of a storage device depends on the geometrical scale, the maximum storage capacity however can be predicted by the isothermal characteristics. The specific adsorption capacity is found to be nearly independent of the degree of contamination.

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 191

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 3, 28, 41, 42, 43, 44, 45, 46, 47, 742, 785, 922

299 **(ANL/CNSV-TM—121) Landfill gas recovery: a technology status report.** Zimmermann, R.E.; Lytwynyshyn, G.R.; Wilkey, M.L. (ESCOR, Inc., Northfield, IL (USA)). Aug 1983. Contract W-31-109-ENG-38. 91p. NTIS, PC A05/MF A01. Order Number DE84001194.

Landfill gas, which consists mainly of methane and carbon dioxide, can be recovered and used as a fuel. Processing will upgrade it to a high-Btu gas of pipeline quality. There are more than a dozen commercial landfill-gas recovery facilities in the US at present, all at relatively large sites. The amount of gas produced by a given site is a function of size, composition, and age of the landfill. Various techniques can be used to enhance gas production and yield, including controlled addition of moisture and nutrients; bacterial seeding and pH control also appear useful. Several computer models have been developed to examine the effects of various parameters on gas production and yield; these can aid in predicting optimum gas recovery and in maintaining the proper chemical balance within the producing portion of the landfill. Economically, a site's viability depends on its location and potential users, current competing energy costs, and legislation governing the site's operation. Legal problems of site operation can occur because of environmental and safety issues, as well as from questions of gas ownership, liability, and public utility commission considerations. Currently, R and D is under way to improve present recovery techniques and to develop new technologies and concepts. Cost comparisons and potential environmental impacts are being examined. Additional research is needed in the areas of gas enhancement, decompositional analysis, computer modeling, gas characterization, instrumen-

tation, and engineering cost analysis. 77 references, 11 figures, 23 tables.

300 **(DOE/EV/10133—T5) Characterization and environmental studies on anaerobic digestion of municipal solid wastes: Pompano Beach plant. Final report.** Sengupta, S.; Wong, K.F.V.; Nemerow, N.; Strietfeld, M.; Narasimhan, R.; Tilles, A. (Miami Univ., Coral Gables, FL (USA). Resource Recovery Group). Aug 1983. Contract AS05-78EV10133. 430p. NTIS, PC A19/MF A01. Order Number DE84001895.

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The purpose of this program is to evaluate and verify the technical and economical feasibiilty of the solid waste to methane fermentation process. Since anaerobic fermentation of solid waste materials has not been demonstrated on a large scale, there is a definite risk factor that the system will not perform as current research suggests. The proof of concept plant was built on an existing shredding and landfill site at Pompano Beach, Florida. Two digesters were built with a total capacity of 90 Mg/day of solid waste. Municipal solid wastes contain numerous substances of potential environmental concern. While some understanding of the composition of raw municipal waste and its leachate products is available, no information regarding characteristics of solid, liquid and gaseous outputs from anaerobic digestion exists. The areas of environmental concerns identified were: output gas quality, leachate (filter cake and filtrate) to groundwater system, wash water streams, filter cake, and filtrate. In order to characterize the effluent streams, the following sampling sites were chosen: air classified heavy fraction, air classified light fraction, digested slurry, output gas, filter cake, filtrate, wash water input, and wash water effluent. The technical approach consisted of physical, chemical, and biological characterization of all outputs at the plant. Analyses for major, minor and trace compounds of potential environmental concern were conducted. Relevant regulatory standards were recognized and searches for compounds on EPA priority pollutant list and carciongen list were conducted. The ultimate aim was to quantitatively relate contaminant potential with plant operating parameters. Some mutagenic studies were conducted. A significant part of the technical approach relates to the development of predictive criterion for pollutant migration by leaching and modeling studies.

301 **(DOE/R4/10299—T1) Grain drier fueled with a biomass gasifier. Final performance report.** Shaw, L.N.; Post, D.M.; Eoff, K.M. (Florida Univ., Gainesville (USA)). [nd]. Contract FG44-80R410299. 8p. NTIS, PC A02/MF A01. Order Number DE84000399.

The basic concept of this agricultural crop dryer is to use a biomass gasifier to energize the drying equipment for agricultural crop drying. A blast of heated air is forced through the commodity that is to be dried and this carries off moisture that can cause spoilage and deterioration. In this research project, the objective was to determine if an engine fueled with producer gas from a gasifier could be utilized to operate a fan and if all of the waste heat from the gasifier, gas filtering equipment and the internal combustion engine could be utilized to heat the air. About 75% of the fuel energy going into an internal combustion engine is wasted in the cooling air and through the exhaust and it was proposed that a very efficient crop drier could be developed if most of this energy could be reclaimed. The waste heat from the air cooled engine, the gas coolers and filters and the gasifier can be used to heat the drying air if these components are placed in a tunnel leading to the drier fan. Design and performance of the gasifier and gas-cleanup equipment are described.

302 **(PNL-SA—11640) Overview of biomass liquefaction activities sponsored by the US Department of Energy.** Stevens, D.J.; Schiefelbein, G.F. (Pacific Northwest Lab., Richland, WA (USA)). 1983. Contract AC06-76RL01830. 7p. (CONF-8309171—1). NTIS, PC A02/MF A01. Order Number DE84002590.

From 33. Canadian Chemical Engineering Society meeting; Toronto, Canada (16 Sep 1983).

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The United States Department of Energy is sponsoring research on the thermochemical conversion of biomass into useable energy forms. This research effort is divided into three technology areas including gasification, liquid fuels, and combustion. In this paper, the organization of the program and a technical overview of present liquid fuels technology research is presented.

303 **Surface and bulk analysis of a deactivated Raney nickel methanation catalyst.** Kelly, R.D. (National Bureau of Standards, Washington, D.C.); Candela, G.A.; Madley, T.E.; Newbury, D.E.; Schehl, R.R. *Journal of Catalysis;* **80**: No. 2, 235-248(Apr 1983).

In a joint PETC-NBS experiment, a Raney nickel methanation catalyst in a hot gas recycle (HGR) bench-scale reactor (used for catalyst lifetime testing) has been examined with a wide range of modern analytical techniques sensitive to both surface and bulk chemical properties of the catalyst. The reactor was designed to use a catalyst essentially identical to that used in previous lifetime testing and to allow both the sampling at various positions along the catalyst bed and the introduction of the samples into the various analytical instruments under inert atmospheric conditions (i.e., without exposure to oxygen, water, etc.). The purpose of this work was to explore the reasons for the premature failure of the catalyst in pilot plant lifetime tests. The results indicate that in spite of significant catalyst deactivation only low levels of carbon (a small fraction of a surface monolayer) are formed on the catalyst surface. The primary cause of catalyst deactivation in this lifetime test was determined to be the growth of the nickel crystallites and subsequent decrease in active catalyst surface area.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 35, 36, 37, 38, 39, 40, 453

304 **(DOE/FE/16122—1491-Vol.1) Keystone Project: coal-to-methanol feasibility study. Volume I. Project summary.** (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). Dec 1982. Contract FG01-81FE16122. 105p. NTIS, PC A06/MF A01. Order Number DE84002541.

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The Keystone Project is proposed to be a facility that would eventually produce up to 67,000 barrels per day (bpd) of fuel-grade methanol from 2330 tons per day of bituminous coals. Initial production capacity of the plant, which could be on stream in early 1988, would be 13,300 barrels per day, could be expanded to the full 67,000 bpd capacity by the addition of unit additional process trains. This approach provides for a rapid and cost-effective implementation of the project with minimum risk. The Feasibility Study involved a comprehensive 18-month evaluation aimed at assessing the viability of the project from technical, economic, financial, marketing, environmental, health and safety, socioeconomics and business aspects. The work scope included seven tasks, which address important issues in the project: Preliminary Facility Design; Economic and Financial Analysis; Market Analysis; Siting Evaluation and Resource Assessment; Environmental, Health, Safety and Socioeconomic Assessments; Detailed Evaluation and Plan for Project Completion; and Program Management. The results provide a body of quantitative and qualitative information on which a decision can be made by interested investors whether to proceed with the project. The following work objectives were accomplished: a preliminary facility design and cost estimates based on a specific site were established; the size and nature of potential markets, probable product prices and key market regulatory issues were evaluated; the commercial feasibility of the project was determined based on economic and financial parameters, such as capitalization and debt structure, local and federal incentives and investor rate of return and cash flow; and environmental, health and safety, socioeconomics and related regulatory aspects of the project were evaluated. The results indicate that the project can be viable if given appropriate financial support from the US Synthetic Fuels Corporation.

305 **(DOE/FE/16122—1491-Vol.2) Keystone Project: coal-to-methanol feasibility study. Volume II. Plant design. Final report.** (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). Dec 1982. Contract FG01-81FE16122. 604p. NTIS, PC A99/MF A01. Order Number DE84002542.

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This volume describes and summarizes the technical/engineering aspects, efforts and results associated with the Keystone Project Feasibility Study. The Keystone Project coal-to-methanol synthetic fuel plant site is located near Cairnbrook, Pennsylvania, in Somerset County. A Westinghouse fluidized bed gasification system will process a locally available, high-sulfur, caking coal into a raw synthesis gas. The gas will then be cooled, shifted and purified prior to being converted to methanol via the Imperial Chemical Industries (ICI) process. The methanol is intended for use as described in the Marketing report (Volume IV). Elemental sulfur, dry ash, carbon dioxide and liquid anhydrous ammonia will be recovered as plant by-products. The project has been sized on an economical, single-module level, processing 2330 tons per day of coal into 13,343 barrels per day of methanol. However, the project can be expanded to a total of five modules with an overall production capacity of 66,500 barrels per day of methanol when market and economic conditions warrant. The technical portion of the feasibility study for the project is divided into several major areas, and the following tasks are reported in this volume: assessment of technology, comparison studies, preliminary plant process design, instrumentation and control systems, capital and operating cost estimates, and project schedule.

306 **(DOE/FE/16122—1491-Vol.3) Keystone Project: coal-to-methanol feasibility study. Volume III. Environmental assessment. Final report.** Beimborn, W.A.; Bedick, R.C.; Chandler, M.W.; Krause, A.J.; Pochan, M.J.; Roffman, A.; Roffman, H.K.; Travis, R.K.; Wagner, D.J. (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). Dec 1982. Contract FG01-81FE16122. 616p. NTIS, PC A99/MF A01. Order Number DE84002543.

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This volume provides the environmental assessment of the Keystone Project as the project was developed by the Keystone Project Coal-to-Methanol Feasibility Study, and establishes the environmental feasibility of the project. Environmental impacts are minimized through the use of a carefully selected site, proven control technologies for air emissions and solid waste disposal and wastewater treatment for zero discharge. Permittability of the plant was established through coordination with permitting agencies. Socioeconomic impacts from construction and operation will be beneficial because of the currently underutilized infrastructures in the area and a local labor force suffering high unemployment. Health and safety requirements can be met. Resources to support operation of the plant are available. This environmental assessment addresses the full five-module plant; and includes information about the first module, which is the basis for plant expansion. This volume and three contract-deliverable supplements comprise the seven major elements of the environmental analysis. Section 2.0, Site Selection, summarizes the selection of a suitable site on the basis of environmental and engineering-economic considerations. Details of the site selection process are given in Supplement KST-3, Keystone Project Site Selection Report. Section 3.0, Environmental Setting, provides a description of the physical, biological and socioeconomic/cultural aspects of the selected site. Air quality and meteorology in the site area were determined by monitoring.

307 **(DOE/PC/50810—T4) Promotion effects on the synthesis of higher alcohols. Fourth quarterly report, June 1983-August 1983.** Goodwin, J.G. Jr.; Chuang, S.C. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Sep 1983. Contract FG22-82PC50810. 16p. NTIS, PC A02/MF A01. Order Number DE84000618.

Zn has been known as an essential element for the methanol synthesis. Although the role of Zn in the synthesis of alcohols is still not clearly elucidated, the use of Zn-promoted catalysts may provide information permitting a better understanding of the role of Zn in CO hydrocondensation. It is therefore worthwhile to compare the effect of alkali promotion in to that by Zn. The effect of alkali promotion of Fischer-Tropsch (F-T) catalysts is well known. In general, upon promotion there is an increase in Co dissociation and hydrocarbon chain growth and a decrease in CH_4 selectivity. In the case of supported metals, such promotion has been found to be directly related to the alkali species-metal interaction and does not require support-metal interactions. Surface science investigations of alkali metal atoms on transition metal surfaces have shown the presence of a transfer of charge from the alkali atoms to the metal surface atoms. Recently, an ESCA study of alkali-promoted Ru/SiO_2 demonstrated the apparent increase in valence electron density in Ru, even though promotion was by K^+ and Na^+ species. The use and effect of other promotes on F-T synthesis have not been studied extensively. Recent results have shown Ru supported on La_2O_3 and ZnO to have interesting properties with respect to F-T synthesis. These properties were high olefin and low methane selectivities compared to Ru on a large number of other supports. Such catalysts, however, have a number of disadvantages. Ru/ZnO has a very low activity, while ZnO and La_2O_3 have very low surface areas (10 to 30 m^2/g) compared to SiO_2 or Al_2O_3. An investigation was carried out to determine the properties for F-T synthesis of La- and Zn- promoted Ru/SiO_2 and to compare these properties to those of Ru/La_2O_3 and Ru/ZnO.

308 **(DOE/R4/01058—T1) Erection and operation of individual alcohol still. Final report.** (Jones (A.C.), Pensacola, FL (USA)). [nd]. Contract AP44-81R401058. 26p. NTIS, PC A03/MF A01. Order Number DE84001131.

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The report describes fabricating, assembling, and operating a simple still following DOE blueprint guidelines in a manner that could be duplicated by more or less non-technical citizens. The performance of these tasks will allow DOE to provide designs of alcohol stills for citizens that will allow the production and utilization of alcohol fuels.

309 **(NMERDI—2-68-2210) On-farm production and utilization of alcohol and stillage. Annual report.** Morin, G.C.A. (New Mexico State Univ., Clovis (USA). Plains Branch Agricultural Experiment Station). Sep 1982. 120p. New Mexico Energy Research and Development Inst., Pinon Building, Room 358, 1220 South St. Francis Drive, Santa Fe, NM 87501.

Using currently available technology and tax incentives, it appears that the production of fuel alcohol from grain grown in New Mexico in small-scale commercial plants is feasible. On-farm production does not appear practical at the present time. Future economic trends indicate that less-expensive feedstocks will be required for this industry to remain viable. Fuel alcohol can be used straight (160 to 200 proof) as a fuel extender or an octane enhancer. The use of alcohol straight appears unfeasible, however, its uses as an extender and enhancer both appear suitable. As an extender, alcohol can be used in both spark-ignition engines (without modifications) and compression ignition engines (with a second fuel system). Research into use in compression ignition engines needs to be continued. As an enhancer, fuel alcohol is currently economic without tax incentives in certain circumstances. Thus, the two major thrusts for the future are: (1) development of new low cost feedstocks suitable for New Mexico; and (2) further work with fuel alcohol in compression ignition engines. 67 tables.

0904 Solid Waste And Wood Fuels

310 **(DOE/R4/10144—T1) Sunflower plants as substitute for wood as heating fuel.** (Solar Crafters, Inc., Strawberry Plains, TN (USA)). [nd]. Contract FG44-80R410144. 7p. NTIS, PC A02/MF A01. Order Number DE84000273.

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The purpose of this grant was to determine the feasibility of using the sunflower plant as a direct substitute for wood as a heating fuel in wood stoves or furnaces. Sunflowers were grown two successive years, the tops were harvested, dried, and stored. Initial problems with explosions when the fuel door was opened on an air tight stove were overcome by compressing the sunflowers into convenient sized logs. The sunflower oil itself was found to have the highest Btu content of any part of the plant. This oil content ac-

counts for the high heat output of the sunflower tops when burned intact. However, since the sunflower oil has been recently shown to be effective as a direct substitute for diesel fuel in combustion engines, the use of the sunflower as a substitute for heating fuel would seem to have a lower priority. The more cost effective use of this oil in the future remains as a food source or combustion fuel source.

311 **(DOE/R4/10156—T1) Development and testing of an automated wood-burning heating system. Final report.** (Martin (Werner), Chapel Hill, NC (USA)). May 1981. Contract FG44-80R410156. 48p. NTIS, PC A03/MF A01. Order Number DE84000383.

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An improved wood continuous, automated combustion system has been developed using a tunnel burner. The tunnel burner implemented into a boiler heating system has proven to be very efficient. The prototype was tested and evaluated. A second generation tunnel system was designed and fabricated. Work performed between April 1980 and April 1981 is summarized. The most important results of the project are: the finalized tunnel burner design; high combustion efficiency; and low air pollution emissions. 3 tables. (DMC)

312 **(N—8323776) Energy saving incineration of waste. Final Report, May 1981.** Meierzukoecker, H.; Voegtli, R. (Technische Univ. Berlin (Germany, F.R.)). Nov 1982. 76p. (In several languages). (BMFT-FB-T—82-194; ISSN—0340-7608). NTIS, PC A05/MF A01.

Bundesministerium fuer Forschung und Technologie.

The mechanism and the dimension of the preoxidation of the pollutants in the heat exchanger were investigated. A temperature control system was developed and tested. It is found that the preoxidation in the heat exchanger depends on the peculiarity of the pollutants and is inhibited by inactive walls with increasing of the specific surface. Active materials like copper only promote the oxidation of all pollutants in the low temperature region. Savings of supplemental energy of about 25% are possible using process controlled auxiliary firing and combustion enthalpy of pollutants as a substitute for the supplemental energy.

13 HYDRO ENERGY

313 **(DOE/R4/10214—T1) Small-scale hydroelectric power in Watauga County, North Carolina.** Ayers, H.G. (Blue Ridge Group Sierra Club, Boone, NC (USA)). 22 Feb 1983. Contract FG44-80R410214. 15p. NTIS, PC A02/MF A01. Order Number DE84000431.

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We have completed both the installation of the demonstration project and the assessment of the stream flows in Watauga County, North Carolina. The 17 kW, high head (178'), project on Laurel Creek in Watauga County has produced about 60,000 kWh over its first nine months of operation despite some electrical and other problems. It is currently producing 16 to 17 kW on a steady basis and is functioning as a popular site for visits by people who plan to install their own similar plants in areas throughout the Southeast. The stream assessment proved to be less satisfactory than the subsequently developed method for predicting long term stream flows. The latter method has been applied to all western North Carolina and this report presents its general conclusions.

1303 Plant Design And Operation

314 **(DOE/R4/10478—T1) Small-hydroelectric-turbine generating system. Final report, June 30, 1981-December 31, 1982.** Kennedy, B.W. (Kennedy (Bobby W.), Guntersville, AL (USA)). 15 Mar 1983. Contract FG44-81R410478. 57p. NTIS, PC A04/MF A01. Order Number DE84000739.

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The historical development of the Pelton waterwheel and the basics of impulse turbines are reviewed. A guide is given for do-it-yourself construction of small hydroelectric plants. Steps to follow in determining the requirements for a do-it-yourself plant are outlined. Final considerations are also given. (DLC)

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 1262

315 **(TVA/PUB—83/45) Vector control activities. Fiscal year, 1982.** Pickard, E.; Cooney, J.C.; McDuff, B.R. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jun 1983. 25p. NTIS, PC A02/MF A01. Order Number DE84900276.

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The goal of the TVA Vector Control Program is to protect the public from potential vectors of disease by controlling medically-important arthropod pests that are propagated on TVA lands or waters. In addition, freedom from annoying mosquitoes and other blood-sucking pests permits the development, use, and full enjoyment of the vast recreational opportunities offered by the many miles of freshwater lakes. To attain this goal the program is divided into operations and support studies. The support studies are designed to improve the operational effectiveness and efficiency of the control program and to identify other vector control problems that require TVA attention and study. Specifically, activities concerning water level management of TVA lakes, dewatering projects, plant growth control, drainage and insect control programs are detailed. Further, report is made of post-impoundment surveys, soil sampling studies of Mosquite larvae and ecological mosquito management studies.

1307 Power Conversion Systems

REFER ALSO TO CITATION(S) 468

14 SOLAR ENERGY

1401 Resources And Availability

316 **(N—8323746) Solar resource.** Raschke, E. (Koeln Univ. (Germany, F.R.)). Nov 1982. 4p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technology, Potential p 17-20 (SEE N83-23743 13-44).

The downward solar radiation at the Earth's surface is modified by scattering and absorption processes in the atmosphere and the geometry between the positions of the Sun and observer. These principles are outlined in this paper with particular attention to the use of satellite measurements for aerial inventories of available solar energy at ground.

1403 Economics

REFER ALSO TO CITATION(S) 662

317 **(N—8323743) Solar Energy 1982: Resources, Technologies, Potential.** Burke, W.R. (European Space Agency, 75 - Paris (France)). Nov 1982. 256p. (CONF-820799—; ESA-SP—181; ISSN—0379-6566; CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

The principles of solar energy conversion are reviewed. The feasibility of applying various solar technologies for the provision of heat and the generation of electricity is discussed. The advantages and disadvantages of various solar technologies are also discussed. For individual titles, see N83-23744 through N83-23775.

318 **(N—8323744) Solar technologies and potential.** Faninger, G. (Austrian Solar and Space Agency, Vienna). Nov 1982. 7p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 309 (SEE N83-23743 13-44).

The rapid escalation of energy costs, the depletion of fossil fuel reserves and especially the increase of global energy requirements necessitate the utilization of all sources of energy, especially of renewables. With the present knowledge it could be expected that solar energy can play a significant role in rural areas in the form of decentralized applications. Many of the solar technologies are ready for immediate use in a multiplicity of applications. Other solar technologies are in an advanced stage of research and development and must be demonstrated, in various climatic zones, on a broad scale in order to prove their technical and economic viability.

319 **(N—8323745) Energy situation and solar option.** Haefele, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Nov 1982. 3p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 11-13 (SEE N83-23743 13-44).

Solar energy as a resource for future energy supply is considered. The energy system is discussed as a whole, paying attention to market penetration mechanisms, and tenacious social infrastructures. Since electricity alone would be insufficient to meet end-user requirements appropriately, this system supplies hydrogen via a widespread second which completes the functions of the well established electricity grid. The combination of both extremely clean secondary energies covers the total spectrum of energy applications.

320 **(N—8323762) On the economics of solar electricity generation.** Gretz, J. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Nov 1982. 2p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 147-148 (SEE N83-23743 13-44).

The development of solar electricity cost models is discussed. In view of the large scattering of component and total plant investment costs, differences in mode of cost calculation, and uncertainty of the solar utilization factor refined cost calculations do not give any more useful information than simple formulae. The competitiveness of solar electricity is addressed with reference to cost projections.

321 **(N—8323763) Socio-economics of solar energy.** Buigues, P.A. (Aix-Marseille-1 Univ., 13 - Marseille (France)). Nov 1982. 7p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

The economic and social status of new and renewable energy sources in the United States and in France is described. The roles of different strategic agents (companies and government) in developing and using these energy resources is also outlined.

322 **(N—8323764) Two alternative solar energy scenarios for Western Europe.** Nakicenovic, N. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Nov 1982. 5p. (CONF-820799—). NTIS, PC A01/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 159-163 (SEE N83-23743 13-44).

Two limiting scenarios that lead to a sustainable energy system in Western Europe toward the end of the next century are described. The scenarios consider exclusively solar energy futures: one based on centralized solar technologies (hard scenario) and the other on decentralized user-oriented technologies (soft scenario). While both scenarios eliminate Western Europe's dependence on domestic and foreign fossil energy sources, the hard solar scenario requires substantial imports of solar produced hydrogen. Fundamental but different changes of the whole energy system, economic structure and lifestyles are necessary in order to achieve sustainable solar energy futures in the scenarios.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 321, 322

323 **(DOE/JPL/766403—83/1) Export Trading Company Act of 1982 and the photovoltaics industry: an assessment. Final report.** Enfield, S.; La Porta, C. (United States Export Council for Renewable Energy, Washington, DC). 2 Sep 1983. Contract NAS-7-100-766403. 43p. NTIS, PC A03/MF A01. Order Number DE83017585.

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The US Export Council for Renewable Energy undertook an assessment of the potential advantages of recent export-promotion legislation for the US photovoltaics industry. The study reviewed the provisions of the Export Trading Company Act of 1982, surveyed the export trade sector to determine what impact the Act is having on export-company activity, and surveyed the photovoltaics industry to begin assessing whether the Export Trading Company Act offers particular advantages to that industry for promotion of its product overseas.

324 **(DOE/R4/10208—T1) Catawba Science Center solar activities. Final report.** (Catawba Science Center, Hickory, NC (USA)). [nd]. Contract FG44-80R410208. 18p. NTIS, PC A02/MF A01. Order Number DE84000436.

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Two demonstration solar water heaters were built. One was to be used at the Science Center and the other with traveling programs. This was completed and both units are being used for these programs which continue. We were able to build a library of 99 solar energy books and booklets that are available to the public for reference. We also conducted programs for 683 students of all ages. The culminating activity was the planned Energy Awareness Festival. This was held on September 26, 1981 and attracted 450 area citizens. We offered free exhibit space and hosted 17 exhibitors.

325 **(DOE/R4/10305—T1) Solar-energy workshops held at Miami-Dade Public Libraries, 1981-1982. Final report.** (Sinz (E.), Miami, FL (USA)). 1982. Contract FG44-80R410305. 12p. NTIS, PC A02/MF A01. Order Number DE84000419.

Over a two year period, the Miami-Dade Public Library System gave 12 free solar energy programs throughout Dade County in its various branches; Solar Water Heater Workshops, where registered participants actually took part in building or putting together a solar water heater. Kick-off programs were also given free-of-charge by a number of local solar companies, to inform the audience about solar energy in general and the solar workshops in particular. Average registered attendance at these workshops was twenty, not including the crowds of onlookers at the outdoor building sessions or the earlier kick-off programs, which often had an audience of sixty or more. A later phone check of ten workshop participants picket at random revealed four who had built or were building their own solar systems, three who were considering the purchase of -or had already bought - a domestic solar water heater, one who was reported to be no longer interested by his son, and two who could not be reached. One of the completed heaters has been donated to a local Girl Scout troop, where it is on permanent exhibit; another will be placed in a new library branch, with appropriate publicity about its source. Florida Power and Light, which formerly viewed our early workshops with suspicion, sent a speaker to our final program to announce financial assistance to those who wanted to buy a solar hot water heater.

326 **(DOE/R4/10412—T1) Upper Sand Mountain Parish Solar Construction Workshops. Final performance report.** (Upper Sand Mountain Parish, Section, AL (USA)). Feb 1983. Contract FG44-81R410412. 33p. NTIS, PC A03/MF A01. Order Number DE84000755.

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The Upper Sand Mountain Parish continues to employ its initial strategy for involving high school vocational students with the pre cutting and instructional assembly aid to area families. The parish project works with high school vocational classes in pre fab-

bing solar devices into kit form. Then, students are employed to serve as instructors for Saturday construction workshops at the local electric cooperative. Trained teams of older and unemployed adults work with youth in building solar greenhouses for those able to pay labor. Over three years, the project has assisted and built 50 to 60 attached solar greenhouses with construction teams realizing in excess of $26,000 in labor for newly developed skills. The project continues to assist owners in monitoring and developing horticulturally as well as energy producing greenhouses. During the spring of 1982, the parish assisted greenhouse owners in marketing over 60,000 bedding plants worth over $3000. Monthly Greenhouse Owner Fellowship meetings have been a helpful setting for sharing of ideas and exchange of insights. A low interest solar loan fund, offering 5% loans for three years, has assisted over 30 families in going solar. The principle for this revolving fund has almost reached the $15,000 mark. The track record for loan repayments has been exceptional. Through workshops and tours we have aquainted hundreds of people across the southeast with low cost/low technology solar projects and a workable strategy for involving community groups and students in them. With church involvement, we have provided over $25,000 in grants to over 200 area families. Workshop information and plans are available to those interested for bread box solar water heaters, food dryers, window box collectors, insulation panels, and greenhouses.

327 **(DOE/R4/10490—T1) Solar home tours for bank officials. Final report.** Boone, R. (Solar Plexus Design, Warne, NC (USA)). [nd]. Contract FG44-81R410490. 17p. NTIS, PC A02/MF A01. Order Number DE84000974.

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A program was conducted to disseminate reliable information about the demonstrated performance of solar houses in the western North Carolina microclimate to banking officials, lending officers, builders, and prospective home buyers. The approach used included tours of solar homes and seminars.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 301, 302, 308, 309, 310, 311, 742, 1137, 1141, 1308

328 **(CONF-831028—4) Beam processing for high-efficiency Si solar cells.** van der Leeden, G.A.; Young, R.T.; Sandstrom, R.L.; Wood, R.F.; Westbrook, R.D. (Oak Ridge National Lab., TN (USA); Helionetics, Inc., Oak Ridge, TN (USA). Laser Processing Lab.; Helionetics, Inc., San Diego, CA (USA). Laser Div.). 1983. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE84002059.

From Photovoltaic solar energy conference; Athens, Greece (17 Oct 1983).

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High-efficiency silicon solar cells have been made using two different techniques for dopant implantation and two types of lasers for annealing of the implantation damage. Regardless of the type of lasers used for the annealing, a 1-KeV glow discharge BF_2 implantation gave higher-efficienty solar cells than conventional mass-analyzed 5 kV ^{11}B implantation. The implanted layers were annealed with XeCl excimer and ruby lasers. Excimer laser annealing was found to give superior results. Spectral-response measurements showed that the higher efficiencies were the result of an improved blue response. The use of glow discharge BF_3 implantation and excimer laser annealing resulted in P^+n cells with AM1 efficiencies greater than 16.5%, as measured at the Solar Energy Research Institute.

329 **(DOE/CS/15077—T7) High-frequency furnace. Technical progress report. Eighth quarterly report for period ending September 30, 1983.** Zumbrunnen, A.D. (Zumbrunnen (Allen D.), Salt Lake City, UT (USA)). 1983. Contract FG01-81CS15077. 6p. NTIS, PC A02/MF A01. Order Number DE84000425.

An important phase of silicon solar cell production via ingot technology is the conversion of polycrystalline silicon to the single-crystal, ingot form that is required for wafering. In the current art such ingots are produced either by pulling from the melt or by various crucible growth techniques. A characteristic of all of these methods, which use bulk melting, is that a refractory crucible is required to hold the molten charge. This imposes the disadvantages that the silicon is always contaminated to some degree by dissolution of the refractory into the melt, which can reduce solar cell efficiency, and the crucibles themselves represent a significant cost factor. Clearly, elimination of the need for a refractory crucible in the melt growth of single-crystal silicon would be an important process improvement. Work to be conducted is to investigate a radical, new heating technique which holds potential for achieving crucibleless melting. Ingots would be pulled from the melt as per conventional practice. Briefly, a high frequency current (10 KHz) is caused to flow on the surface of a mass of metal as a result of skin effect and proximity effect. By controlling the power input and heat losses from the billet it is anticipated that it will be possible to form and maintain in its top surface a molten pool which will be contained in a solid, outer layer or skull of metal. The basic objectives of the project are to prove the general feasibility of this melting technique. This is to be accomplished by building and operating a small, experimental furnace. To simplify the project as much as possible and to minimize research costs, cast iron will be used in place of silicon for melt experiments.

330 **(EUR—7824-EN) Project C: photovoltaic solar-energy conversion. Abstracts of final reports for the period 1978-1979.** (Commission of the European Communities, Luxembourg). 1983. 237p. European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

A number of brief summary reports is given that give the main results of research programs in the areas of: silicon solar cells, alternative types of solar cells, new methods for preparing silicon material, photovoltaic module development, photovoltaic concentrators, small and intermediate photovoltaic power systems. (LEW)

331 **(FRNC-TH—1158) Molten bath preparation and study of the Gesub(1-x) Sisub(x) alloy.** Ouertani, R. (Montpellier-2 Univ., 34 (France)). 1981. 162p. (In French). NTIS (US Sales Only), MF A01. Order Number DE84750126.

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The Gesub(1-x) Sisub(x) solid solution can be useful for making very high-yield photocells but its preparation as homogeneous monocrystals, is also difficult. The first aim of this work, the manufacture of germanium-rich Gesub(1-x) Sisub(x) monocrystals, seems to have been attained for silicon contents below 4 at %. Theoretical and experimental studies led to the development of two manufacturing techniques: Czochralski extraction (modified) and horizontal zone melting. From the electrical characterisation of p type Gesub(1-x) Sisub(x) samples ($0 < x < 0.03$) the activation energy of the residual acceptors was evaluated. Low-temperature conduction takes place via an impurity band, with diffusion through dislocations characterised by low mobility, proportional to T. The second object was to make and study Gesub(1-x) Sisub(x) - based homojunctions. The n-p junction is obtained by diffusion of arsenic on a series of Gesub(1-x) Sisub(x) substrates ($x < 0.015$). The junction depths were determined by EBIC and chemical attack. The diffusion coefficients of As in Gesub(1-x) Sisub(x) were measured at 600 and 700°C. Vacuum annealing at 500°C improved mobility and reduced the joint depths. The electrical and photovoltaic characterisation of the diffused n-p junctions concerned the diffusion, lengths and the current-voltage properties. The photovoltaic conversion yields fall distinctly below the calculated values but should be improved by optimisation of the manufacturing parameters. The application of models based on a correlation of damage with crack length is limited to the propagation stage. Experience shows that fatigue cracks and cavities are not initiated during the first cycles, especially in the region of slight deformations.

332 **(N—8323713) Modeling of polymer photodegradation for solar cell modules.** Guillet, J.E. (Toronto Univ., Ontario (Canada); Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1982. 9p. (NASA-CR—170230; JPL—9950-811). NTIS, PC A02/MF A01.

The photodegradation of synthetic polymers, used as pottants and/or cover sheets in the FSA solar cell module designs, is modeled.

333 **(N—8323714) Modelling of polymer photodegradation for solar cell modules.** Guillet, J.E. (Toronto Univ., Ontario (Canada); Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1982. 11p. (NASA-CR—170231; JPL—9950-812). NTIS, PC A02/MF A01.

A computer program is outlined which simulates the complex processes of photooxidation which take place in a polymer upon prolonged exposure outdoors, causing it to fail in photovoltaic and other applications. The method calculates from an input data set of elementary reactions and rates the concentration profiles of all species over time.

334 **(N—8323749) Solar thermal conversion.** Winter, C.J. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.)). Nov 1982. 7p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 35-41 (SEE N83-23743 13-44).

A systematic description of solar energy utilization on Earth is given. The basic physics of solar energy conversion into heat by means of conduction, convection and radiation are briefly outlined. Examples of existing thermal converters and a list of potential weak-points for future investigations conclude the paper.

335 **(N—8323757) Photovoltaic energy converters: Fundamentals and advanced concepts.** Bloss, W.H. (Stuttgart Univ. (Germany, F.R.)). Nov 1982. 5p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 99-103 (SEE N83-23743 13-44).

The basic physics of photovoltaic energy conversion devices based on semiconductors is outlined. The significant role of the solar spectrum and of the material parameters absorption coefficient and diffusion length of the semiconductors as well as the consequences with respect to material selection are discussed. The potentials of conventional flat plate and concentrating systems and the special advantages of advanced systems such as tandem configurations and those including dispersive and concentrating elements are outlined.

336 **(N—8323758) Silicon solar cells for flat plate photovoltaic systems.** Rodot, M. (Centre National de la Recherche Scientifique, 92 - Meudon-Bellevue (France)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 105-110 (SEE N83-23743 13-44).

The best cost effective solar cells (8 to 10 watt) are made of crystalline silicon. Their evolution is based on the emergence of a new material, solar grade Si, which is less pure and perfect than the electronic grade material used today. The physics, chemistry, and crystal growth aspects of solar grade Si are discussed. Together with other improvements, this material allows a cost of 3 to 4 $/watt in 1985 and brings photovoltaic generators in close competition with diesel engines. Amorphous Si is also briefly mentioned.

337 **(N—8323760) Photovoltaic testing.** Bogus, K. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Nov 1982. 11p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 123-133 (SEE N83-23743 13-44).

Commonly used performance tests covering indoor and natural sunlight methods are reviewed. The historical and rational background of these methods is depicted and the experience gained at ESTEC in the frame of space and terrestrial programs is described. Moreover, the general objectives and requirements for environmental tests are discussed. Finally, typical examples for environmental test schedules are presented for space solar cells and terrestrial solar cell modules.

338 **(N—8323775) Workshop 5: Design of a photovoltaic generator for a refuge in the Alps.** Roger, J.A. (Centre National de la Recherche Scientifique, Lyon (France)). Nov 1982. 4p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 231-234 (SEE N83-23743 13-44).

The design of a photovoltaic (PV) generator for a refuge located in the mountains (+5 deg north, 4 deg east) at an altitude of 2600 m is discussed. This refuge has a capacity of 90 persons and is not connected to the grid. it is at present equipped with a 14 kVa diesel generator operating in a three phase plus neutral mode. This group provides electricity to various domestic appliances: lighting, heat (in the keeper's room), refrigeration, water pumping, etc. Starting from available documents and data, the task was to design the PV generator to be substituted for this diesel engine. The work was divided in several steps: analysis of the existing loads and of the correspondingconsumptions, estimation of the solar energy available on the site, choice of the PV chain necessitating as few modifications as possible in the existing installation, sizing of the elements of the PV chain and scheme of the various parts, and modifications that can be done regarding the loads, and related changes in the design of the system.

339 **(N—8325105) Calibration of pyrheliometers and pyranometers for testing photovoltaic devices.** Zerlaut, G.A. (DSET Labs., Phoenix, AZ (USA)). 1981. 11p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 183-193 (SEE N83-25093 14-44).

The status of pyranometer and pyrheliometer calibration techniques was reviewed. The intercomparison of absolute cavity pyrheliometers is discussed. A round robin experiment performed to isolate various aspects of calibration methods suggests that a much more rigorous approach is required for calibrations of pyranometers to be employed in solar device testing. Tilt effects, however small, deviation from cosine law, and temperature related responsivity, can cause errors in the assessment of efficiency of solar devices. The importance of absolute cavity pyrheliometer intercomparisons, is demonstrated.

340 **(N—8325106) Source for reference cells.** Addiss, R.R. Jr. (Solar Power Corp., Woburn, MA (USA)). 1981. 6p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 195-200 (SEE N83-25093 14-44).

The development of a consensus to establish a source of reference cells is discussed. To do this both the technical and institutional barriers which may exist, and what needs to be done to overcome these are considered. Potential problems are identified. The need for defining standard illumination of conditions is outlined. The ability to measure electrical outputs under nonstandard illumination conditions which allow the results to be related to standard conditions is discussed. The most effective way to do this is to use a properly calibrated reference cell which has a suitable spectral response. The calibration of these reference cells must be performed by an independent, impartial, reliable organization which ensures that all reference cells in use throughout the industry have their calibration based on the same accepted standard conditions.

341 **(N—8325107) Approved laboratory program for photovoltaic reference cell development.** Thomas, D.B. (National Bureau of Standards, Washington, DC (USA)). 1981. 4p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 201-204 (SEE N83-25093 14-44).

The search for a laboratory program to provide a source of photovoltaic reference cells and to identify at least one laboratory which is competent to fabricate, calibrate, and certify reference cells was investigated. The evaluation of candidate laboratories and selection of the best qualified to serve as an approved laboratory for providing reference cells is discussed. These reference cells are used in the measurement of the electrical output of solar cells and modules.

342 **(N—8325108) Progress in the development of standad procedures for the global method of calibration of photovoltaic reference cells.** Whitaker, R.D.; Purnell, A.W.; Zerlaut, G.A. (DSET Labs., Phoenix, AZ (USA)). 1981. 15p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 205-219 (SEE N83-25093 14-44).

The defining of an efficient and accurate procedure for calibration of photovoltaic reference cells by the global method is discussed. A range of the pertinent atmospheric parameters are sampled in experiments which characterize reference cells by at least two different methods using hemispherical illumination. An altazimuth mount to maintain stable solar radiation on silicon reference cell test samples is utilized. The desirability of the global calibration procedure is confirmed. Limitations of the method are identified. The complete experimental plan is described.

343 **(N—8325109) Solar cell measurements.** Curtis, H.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. 7p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 227-233 (SEE N83-25093 14-44).

The measurement of the electrical performance characteristics of individual solar cells is discussed. One of the reasons is determination of the output power, measurement of the effect of various degradation mechanisms, and separation of cells by current and voltage for eventual use in series and parallel combinations. Major problem areas in making accurate performance measurements are the determination of the irradiance level during measurement, the measurement and control of cell junction temperature, and the contacting of the separate current and potential leads to the cell under test. Solar cells respond to only part of the solar spectrum, irradiance measurement made with blackbody detectors lead to spectral mismatch errors. The use of reference cells with a spectral response similar to that of the test cell reduces this error. Reference cells are calibrated at standard atmospheric conditions with all cells calibrated at the same conditions.

344 **(N—8325110) Spectral response measurements for solar cells.** Hartman, J.S.; Lind, M.A. (Pacific Northwest Lab., Richland, WA (USA)). 1981. 8p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 235-242 (SEE N83-25093 14-44).

Spectral response measurements, measurement systems, and potential measurement problems relative to the characterization of solar cells are presented. Measurement systems are outlined for determining the spectral response, external quantum efficiency, and internal quantum efficiency of solar cells. Practical system components and measurement systems are presented along with their potential advantages and weaknesses. Several solar cell properties which must be considered before a measurement system can be designed to evaluate a specific type of solar cell are discussed.

345 **(N—8325111) Development of a standard test method for measuring photovoltaic cell performance. A status report.** Pernisz, U.C. (SES, Inc., Newark, DE (USA)). 1981. 8p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Wrokshop Proc. p 243-250 (SEE N83-25093 14-44).

The development of a standard method for the measurement of the electrical performance of photovoltaic devices which were used on space simulation and applications of space technology is described. A draft document was copied from a report on terrestrial photovoltaic measurement procedures. Measurement procedures are discussed. The photovoltaic power system and standard writing activities are proceeded with the objective of reaching standard methods for measuring the electrical performance of photovoltaic devices.

346 **(N—8325112) Developments toward an 18% efficient silicon solar cell. Final Report.** Meulenberg, A. Jr. (Communications Satellite Corp., Clarksburg, MD (USA)). Apr 1982. 142p. (NASA-CR—168141). NTIS, PC A07/MF A01.

Limitations to increased open-circuit voltage were identified and experimentally verified for 0.1 ohm-cm solar cells with heavily doped emitters. After major reduction in the dark current contribution from the metal-silicon interface of the grid contacts, the surface recombination velocity of the oxide-silicon interface of shallow junction solar cells is the limiting factor. In deep junction solar cells, where the junction field does not aid surface collection, the emitter bulk is the limiting factor. Singly-diffused, shallow junction cells have been fabricated with open circuit voltages in excess of 645 mV. Double-diffusion shallow and deep junctions cells have displayed voltages above 650 mV. MIS solar cells formed on 0.1 ohm-cm substrates have exibited the lowest dark currents produced in the course of the contract work.

347 **(N—8327877) Growth and characterization of Czochralski-grown n and p-type GaAs for space solar cell substrates. Final Report, 29 May 1981-28 May 1982.** Chen, R.T. (Rockwell International Corp., Thousand Oaks, CA (USA)). Jun 1983. 51p. (NASA-CR—168099). NTIS, PC A04/MF A01.

Progress in LEC (liquid encapsulated Czochralski) crystal growth techniques for producing high-quality, 3-inch-diameter, n- and p-type GaAs crystals suitable for solar cell applications is described. The LEC crystals with low dislocation densities and background impurities, high electrical mobilities, good dopant uniformity, and long diffusion lengths were reproducibly grown through control of the material synthesis, growth and doping conditions. The capability for producing these large-area, high-quality substrates should positively impact the manufacturability of highly efficiency, low cost, radiation-hard GaAs solar cells.

348 **(ORNL/Sub—81-9050/1) Energy and chemicals from woody species in Florida. Final report, April 17, 1978-May 16, 1983.** Rockwood, D.L.; Comer, C.W.; Conde, L.F.; Dippon, D.R.; Huffman, J.B.; Riekerk, H.; Wang, S. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 204p. NTIS, PC A10/MF A01. Order Number DE84002377.

The purpose of this program is to: (1) evaluate performance of selected tree species on certain site types and under various management strategies; (2) identify the best management strategies and expected productivity rates for these species; (3) make economic/energetic assessments for sand pine, slash pine, and Eucalyptus grandis and recommend the most desirable management strategies; (4) estimate increases in biomass productivity possible through genetic selection; (5) assess Florida's land resource in combination with possible production levels to estimate statewide woody biomass production potential; (6) examine potential for increasing productivity by modifying wood properties; (7) evaluate implications of intensive culture for nutrient, water, and other environmental factors; and (8) define major challenges and research needs for short rotation woody crops in Florida. Independent surveys were conducted to determine land availability for production of biomass. Fifteen species were evaluated for production potential in natural stands in Florida. Four species - sand pine, slash pine, E. grandis, and E. robusta - have been widely grown for pulpwood production, and associated management systems were well established. The remaining eleven species evaluated possess many of the traits needed for intensive culture. Portions of our major studies have examined the matter of water use resulting from intensively grown trees, and monitoring of these plots since study initiation has provided for assessment of changes in water chemistry. Soil analyses and nutrient determinations of tree components over time have made possible the construction of nutrient balances. With the nutrient balances, the prospects for long-term production on the nutrient-poor soils common in Florida have been estimated. 62 references, 29 figures, 106 tables.

349 **(PB—83-238899) Salvage and thinning operations in second-growth ponderosa pine stands. Forest service research paper.** Host, J.R.; Lowery, D.P. (Forest Service, Ogden, UT (USA). Intermountain Forest and Range Experiment Station). Jun 1983. 17p. NTIS, PC A02/MF A01.

Wood from salvage and thinning operations in second-growth stands in western National Forests constitutes a potential

resource that may help alleviate present and future timber shortages. This report presents cost information and describes harvesting systems and machines that have satisfactorily and economically operated in such stands.

350 **(SAND—83-2219C) Photovoltaic concentrators: recent developments.** Boes, E.C. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 7p. (CONF-831028—1). NTIS, PC A02/MF A01. Order Number DE84001641.

From Photovoltaic solar energy conference; Athens, Greece (17 Oct 1983).

We now have performance and reliability data on several PV concentrator array fields. The 3 fields which use Fresnel lense concentrators are operating very well, with typical field operating efficiencies of 8 to 10% and no serious power degradation to report. Three achievements in the area of module research are reported. Intersol Power has developed commercial modules whose peak (28°C cell temperature, 800 W/m²) conversion efficiency is above 15%. Sandia has fabricated a 200X experimental module using Si cells that is likely to have a peak efficiency of 16.5% (individual lense-cell units have efficiencies between 16.5 and 17%). Lastly, we have tested Varian's passively cooled 1000X GaAs module at 17% peak efficiency. This paper also reports the results of 2 recent studies. The first is a comprehensive study of the effects of real solar spectral variations on the annual performance of 2-cell multijunction devices. The second compares the cost-effectiveness of future concentrator module technologies using Si, GaAs, and AlGaAs/Si multi-junction concentrator cells.

351 **(SERI/TP—211-2048) Progress in polycrystalline thin-film solar cells.** Zweibel, K.; Hermann, A.; Mitchell, R. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1983. Contract AC02-77CH00178. 6p. (CONF-830839—2). NTIS MF A01. Order Number DE83012131.

From Solar world congress; Perth, Australia (15 Aug 1983).

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Photovoltaic devices based on several polycrystalline thin-film materials have reached near and above 10% sunlight-to-electricity conversion efficiencies. This paper examines the various polycrystalline thin-film PV materials including $CuInSe_2$ and CdTe in terms of their material properties, fabrication techniques, problems, and potentials.

352 **High-efficiency Si solar cells by beam processing.** Young, R.T.; van der Leeden, G.A.; Sandstrom, R.L.; Wood, R.F.; Westbrook, R.D. (Helionetics, Incorporated, San Diego, California 92123 and Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Applied Physics Letters;* **43**: No. 7, 666-668(1 Oct 1983). Contract W-7405-ENG-26.

Utilizing two recently developed beam processing techniques, i.e., gas discharge implantation and XeCl excimer laser annealing, p-n junction silicon solar cells with total area (~2 cm²) AM1 efficiencies as high as 16.5% have been made. These cells are of a particularly simple structure, fabricated without any sophisticated processing steps, and subjected to no high-temperature treatment.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 323, 330, 350

353 **(DOE/NASA—0207-1) Modular photovoltaic stand-alone systems. Phase I. Final report.** Naff, G.J.; Marshall, N.A. (Hughes Aircraft Co., Long Beach, CA (USA). Support Systems). Feb 1983. Contract AI01-76ET20485. 247p. (NASA-CR—168075; HAC-F—107-500-5). NTIS MF A01. Order Number DE84001694.

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A Phase I program plan was developed and implemented leading to the detail design of an optimized low power, reliable, low life cycle cost stand-alone photovoltaic (PV) system. Modularity was established in power increments of 0.25 kWp in the range of 0.5 to 16 kWp. The investigations, analyses and designs addressed the balance-of-systems (BOS) elements and subsystems, the PV cells and modules having been designated as an available technology conforming to JPL Block IV, Specification 5101-830. A survey of existing BOS developments was conducted and state-of-the-art BOS designs were generated, evaluated and used in cost trade-offs. A matrix of BOS attributes led to the selection of seven conceptual designs consisting of various BOS elements or combinations thereof. Three of the conceptual designs were selected for further evaluation, preparation of preliminary designs and refinements in life cycle cost trade-offs. The design emerging as the most optimum configuration was selected as the final design candidate. Detail drawings, equipment listings, procurement specifications, test procedures, and production cost estimates were developed in preparation for the Phase II breadboarding of critical control and load management circuits and for the development of an engineering model. Results of the study and designs showed that lead acid batteries are the only practical, near term, available source for electrical energy storage, and, for stand-alone PV power systems, are the major cost driver contributing between 60 to 70% of total system 20 year life cycle costs. For the established range of performance there were only small cost variances between different designs of a given element. It was also shown that properly adjudicated regulation and load management contribute significantly both to reductions in system sizing and improvements in battery life.

354 **(N—8323761) Photovoltaic applications.** Groth, H. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Wedel (Germany, F.R.)). Nov 1982. 11p. (CONF-820799—). NTIS, PC A1/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 135-145 (SEE N83-23743 13-44).

The utilization of photovoltaic generators in measuring and signalling installations, communication systems, water pumping, and electric power plants is discussed. The advantages of solar generators over conventional power supply equipment are outlined.

355 **(N—8323769) Solar power satellites: A review of the state of research.** Kassing, D. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Nov 1982. 7p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 191-197 (SEE N83-23743 13-44).

The main results of the recently completed Solar Power Satellite concept development and evaluation studies in the U.S. and of additional studies in Europe are reviewed in respect to the technical feasibility, economic practicality, and social and environmental acceptability of the concept. Possible consequences for Europe for future research and development in related areas are discussed. Emphasis is given to the photovoltaic reference system used as a strawman concept in the U.S. comparative assessment. Some other advanced photovoltaic satellite concepts with promising benefits against the reference system are also reported.

356 **(PB—83-241984) System analysis of the interconnection of 5 kw solar panels with the power lines. Final report.** Vanwormhoudt, M.C.; Baert, D.H.J.; Van Hoogenbemt, G.H.; Bonte, L.; Allais, L. (Commission of the European Communities, Luxembourg). [nd]. 130p. (EUR—8216-EN). NTIS, PC E07/MF E07.

The development of dc-ac inverter circuits which can be used for the connection of solar panels with the power grid is reported. A solar power simulator of 700 W has been developed and two inverters have been examined. The first is a high-efficiency switching regulator inverter (SRI) for feeding the power grid with a clean sinusoidal current at zero power factor. The second is a phase controlled rectifier (PCR) used as an inverter.

357 **(SAND—83-1019C) Review of the experiences of the US Department of Energy photovoltaic Residential Experiment Stations.** Biringer, K.L.; Menicucci, D.F. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 12p. (CONF-831028—2). NTIS, PC A02/MF A01. Order Number DE84001538.

From Photovoltaic solar energy conference; Athens, Greece (17 Oct 1983).

The residential system experiments portion of the US Department of Energy (DOE) Photovoltaic (PV) Program is designed to answer questions on the design, installation, and operation of small roof-mounted PV systems. The information learned is then fed back into the other system and component development portions of the program to improve understanding of these systems. The area of emphasis is grid-connected PV systems that operate interactively with the local utility. This paper describes the residential experiment stations built to test and evaluate residential PV systems and focuses on a number of experiences to date. Addressed also are some of the remaining unresolved issues and the plans for specific data analysis and experimentation aimed at answering the remaining questions.

358 **(SAND—83-2228C) Evaluation of power conditioning for photovoltaic applications.** Bower, W.I.; Key, T.S.; Petterson, B.J. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 6p. (CONF-831028—3). NTIS, PC A02/MF A01. Order Number DE84001537.

From Photovoltaic solar energy conference; Athens, Greece (17 Oct 1983).

The most complex and most vulnerable component in a photovoltaic system is the power conditioner (PCS). To improve performance and reliability of photovoltaic PCS hardware, an engineering evaluation program was established (1). The primary focus is to characterize performance, to identify potential operating problems, and to work with the manufacturer in correcting these problems. A unique test facility has been developed at Sandia National Laboratories. This facility provides controllable interfaces, specialized instrumentation, and appropriate procedures to provide detailed and consistent evaluation data available PCS hardware. Over the past 9 months several single-phase PV PCSs were evaluated. The major emphasis is evaluation over a wide range of operating conditions and extremes that cannot be accomplished either at the factory or in the field. The contributions of this work to development of photovoltaic systems are accelerated identification PCS design problems and solutions, established performance criteria and test procedures, and reported characteristics of state-of-the-art PCS hardware. Test procedures developed for this activity will be made available to both industry and standards organizations. The facilities and required procedures for evaluation of single-phase PCS hardware up to 10 kW are presented here. They are currently being used for basis residential size (up to 10 kW) evaluations. In the future PCS evaluation including a small signal loop gain and phase analysis is planned. Three-phase intermediate size PCS analysis up to 50 kW and reduced scale central station up to 50 kW concept testing is also planned.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 406, 413

359 **(AD-A—130951/7) Solar thermal system engineering guidebook. Final report 24 sep 82-31 may 83.** Selcuk, M.K.; Bluhm, S.A. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1983. 64p. (JPL-PUB—83-41). NTIS, PC A04/MF A01.

This report presents a graphical methodology for the preliminary evaluation of solar thermal energy plants by Air Force base civil engineers. The report is organized as a Guidebook with worksheets and nomograms provided for rapid estimation of solar collector area, land area, energy output, and thermal power output of a solar thermal plant. Flat plate, evacuated tube, parabolic trough, and parabolic dish solar thermal technologies are considered.

360 **(DOE/R4/10238—T1) Solar-gravity engine renamed the waterless waterwheel.** (Sanders (Willard), Old Hickory, TN (USA)). 25 Jul 1982. Contract FG44-80R410238. 11p. NTIS, PC A02/MF A01. Order Number DE84000670.

Portions are illegible in microfiche products.

The objective of this project was to design and build a low cost simple solar heat engine that would develop torque that could be used to run a pump, saw or an electric generator. The main design criterior was to fabricate this machine with the home handyman in mind. Only materials would be used that could be found in hardware stores. Common methods and common tools would be used to keep cost at a minimum. The wheel did function, but the revolutions per minute were not fast enough to generate electricity because of a design and fabrication problem with the tanks. Tank design will change when a full scale wheel is built in late 1982.

361 **(N—8323753) Systems with medium and high temperature thermal conversion.** Kleinrath, H.F. (Technische Univ., Vienna (Austria)). Nov 1982. 5p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 61-65 (SEE N83-23743 13-44).

Solar thermal power plants are no longer a new technology. Many of their components are so called conventional equipment, some new components are out of their infancy but not yet fully developed. There are several pilot plants, but they are not in operation long enough to speak about routine. First experience does exist, but as usual much of it is just how to do it furtheron better". The report tries to answer the following questions: what is the state of the art, of which kind are the problems still unsolved, what can be done in order to accelerate further development.

362 **(N—8323754) Solar power towers.** Etievant, M.C. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Nov 1982. 12p. (In French). (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

Experimental solar power towers actually in construction or already in existence in the world are described. Seven of these installations are examined: three involve water vapor with solar superheating (EURELIOS, CESA 1, SOLAR ONE), two involve saturated water vapor (NIO, CES 5), one involves sodium (SSPS, CRS), and one molten salt (TEMIS). The principal characteristics of these receivers are presented as well as some results of economic studies of heliostat construction and the cost of electricity.

363 **(N—8323755) Distributed Collector Systems (DCS) for the medium temperature range.** Kalt, A.C. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Nov 1982. 7p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 81-87 (SEE N83-23743 13-44).

The basic layout of a distributed collector system (DCS) is described and questions concerning design are discussed. Plant designs and performance data for four DCS systems are presented. Energy storage techniques, the power conversion cycle, and heat transfer subsystems are addressed.

364 **(N—8323756) Small integrated solar energy systems for developing countries.** Schreitmueller, K.R. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.)). Nov 1982. 7p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 89-95 (SEE N83-23743 13-44).

Solar enegy applications in developing countries cover processing of food and other agricultural products, fresh water produc-

tion, operation of cooling and freezing equipment, water pumps and processing machinery. Evacuated tubular collectors turn out to be best suited for process heat generation and photovoltaic generators for electricity production. The Mexican fishing village of Las Barrancas gives a good example of an integrated solar energy system.

365 **(N—8323773) Workshop 3: Central receiver systems.** Becker, M. (Ecole Centrale des Arts et Manufactures); Etievant, M.C. (Joint Research Centre of the European Communities). (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Nov 1982. 3p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 221-223 (SEE N83-23743 13-44).

The basic design data is given for a 5 MW solar thermal power tower. Specifications are for the geographical and meteorological conditions of Almeria, Spain. The objectives were to consider the total system, to understand contexts and possible options, to discuss technical consequences, and finally to decide upon reasonable solutions.

366 **(N—8323774) Workshop 4: Design of a 100 kWe DCS solar power plant.** (European Space Agency, 75 - Paris (France)). Nov 1982. 4p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 227-230 (SEE N83-23743 13-44).

The design of a 100 kWe solar generator is discussed. The rough design of the steam circuit is discussed, as is the choice of a temperature range for the collector and storage medium. The layout of the collector field and heat storage tanks are given. Heat losses are calculated.

367 **(N—8323778) Solar thermal power plant 30/50 kWe. German-Spanish cooperation project AUXINI/M.A.N.. Final Report, Feb. 1982.** Kraft, M. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Muenchen (Germany, F.R.)). Nov 1982. 48p. (In several languages). (BMFT-FB-T—82-198; ISSN—0340-7608). NTIS, PC A03/MF A01.

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The development of solar farm plants is discussed. A test site was built containing a testhouse, street, workshop and sufficient measurement equipment. In 1980 the test site was increased to 18.000 sq m, and an additional office building was erected. The installed Solar Thermal Power Plant consists of three collector fields with a total collector area of 582 sq m a tankfarm storage system, with a capacity of 1,15 MWh th. at a temperature increment of 100 K, a primemover circuit with a screw expander about 50 KWe peakpower output and a control and supervision system. The tests are concentrated on components and the system for the production of thermal energy, which will be applied to industrial processes.

368 **(N—8323784) Gas-cooled solar tower power plant for the generation of electrical power in the range of 20 MW (GAST). (Detail design phase 2A). Final Report, Nov. 1981.** Wehowsky, P. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). Dec 1982. 35p. (In several languages). (BMFT-FB-T—82-208; ISSN—0340-7608). NTIS, PC A03/MF A01.

Bundesministerium fuer Forschung und Technologie.

The detail design phase of a 20 MWe gas cooled solar tower power plant (GAST) was examined. The goal of phase 2/2A was the detail engineering and design of the reference concepts of the plant system and subsystems developed within the preliminary design phase and to start test work required for the erection of the pilot plant. The construction of the pilot plant, originally planned to be finished within a very short time, can not be continued.

369 **(SAND—83-7124) 1982 annual report of the Coolidge solar irrigation project.** Larson, D.L. (Arizona Univ., Tucson (USA). Dept. of Soils, Water and Engineering). Oct 1983. Contract AC04-76DP00789. 123p. NTIS, PC A06/MF A01. Order Number DE84001081.

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The Coolidge Solar Irrigation Facility at Coolidge, Arizona consists of a 2140.5-m² (23,040-ft²) line-focus collector subsystem, a 13.6-m³ (30,000 gal) thermal storage subsystem, and a 150-kW/sub e/ power generation unit. The purpose of this document is to report the performance of the facility and its operational and maintenance requirements. This document covers the period of time from 1 September 1981 through 30 September 1982. This is the third in a series of annual reports on the operation of the Coolidge Solar Irrigation Facility.

370 **(SAND—83-7125) Final report of the Coolidge solar irrigation project.** Larson, D.L. (Arizona Univ., Tucson (USA). Dept. of Soils, Water and Engineering). Oct 1983. Contract AC04-76DP00789. 82p. NTIS, PC A05/MF A01. Order Number DE84001686.

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The Coolidge Solar Irrigation Facility at Coolidge, Arizona consists of a 2140.5-m² (23,040-ft²) line-focus collector subsystem, a 13.6-m³ (30,000 gal) thermal storage subsystem, and a 200-kW/sub e/ power generation unit. The purpose of this document is to report the performance of the facility and its operational and maintenance requirements during the projects duration, 1 October 1979 through 30 September 1982. This report summarizes information contained in the three annual reports on operation of the Coolidge Solar Irrigation Facility.

371 **(SAND—83-8027) 10-MWe solar-thermal central-receiver pilot plant: 1982 operational test report.** Bartel, J.J. (Sandia National Labs., Livermore, CA (USA)). Nov 1983. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01. Order Number DE84002676.

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The design and construction of the world's largest solar thermal central receiver electric power plant were completed in 1982. Start-up was accomplished, and the plant began the two-year experimental Test and Evaluation phase. Experiences during 1982 have shown that all parts of the plant - especially solar unique ones - operate as well as or better than expected. It was possible to incorporate routine power production into the Test and Evaluation phase because plant performance yielded high confidence. The million kilowatt-hours net, generated while the plant was grid-connected, are an indication of the successful start-up and test experience in 1982. During 1982, the transfer of the plant to operation by utility personnel was also accomplished. Events reported here are not unique to utility operations; an important lesson learned is that solar technology is amenable to operation in conventional utility practices. This report contains (1) a brief description of the plant system; (2) a summary of the year's experiences; and (3) a monthly list of principal activities and operation and maintenance costs.

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REFER ALSO TO CITATION(S) 53, 324, 421, 597, 704, 704, 705

372 **(DOE/CH/10115—T1) MIT Crystal Pavilion: preliminary performance.** Johnson, T.E.; Hubbell, B. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Architecture). Feb 1983. Contract AC02-82CH10115;AC02-77CS34513. 37p. (DOE/CS/34513—T1). NTIS, PC A03/MF A01. Order Number DE84001375.

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Many winter climates in the US and Europe can be characterized as benign, where most of the days are cloudy, yet air temperatures rarely go below 6°C (42°F). The MIT Crystal Pavilion has been built to demonstrate 100% solar heating can be accomplished in these climates using the diffuse radiation that filters through the clouds. The vertical surfaces on the 38m² (416 ft²) addition to the MIT Solar Building No. 5 are glazed with double glass filled with argon and coated on one side with a transparent, low emissivity layer that gives an overall solar transmission of 63% and a nighttime U value of 1.24 W/m² °C. The roof is double

glazed with a low emissivity reflective glass and a laminated glass to reject summer solar gains. The floor is veneered with tiles filled with phase change material to store any beam energy that is available. The building was completed for monitoring during February 1982. Measurements showed the building experiences a daily average lift of 10.3°C above ambient air temperature during cloudy days occurring near the equinox. One hundred percent solar heating cannot be accomplished within 8 weeks of the solstice because of short solar exposure times. Internal gains account for 4.1°C of the daily average lift. Summertime indoor air temperatures do not exceed ambient by more than 1°C on sunny days.

373 **(DOE/R4/10098—T1) Passive preheating of water-heater feed water (using attic heat).** Knudsen, E.T. Jr. (Knudsen (Edward T., Jr.), St. Petersburg, FL (USA)). Jan 1982. Contract FG44-80R410098. 34p. NTIS, PC A03/MF A01. Order Number DE84000745.

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Baseboard convectors were installed in a house attic to preheat water prior to entering the home water heater. The system was monitored and not found to be cost effective. (LEW)

374 **(DOE/R4/10113—T1) Greenhouse effect.** (Trickel (Charles), Inverness, FL (USA)). 1982. Contract FG44-80R410113. 14p. NTIS, PC A02/MF A01. Order Number DE84000740.

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A fiberglass greenhouse was built on the roof of a mobile home in Central Florida. It was learned that direct sunlight is essential for proper winter operation and ventilation is required during hot months to prevent overheating. (LEW)

375 **(DOE/R4/10122—T1) Clemson Outdoor Passive-Solar Laboratory. Progress report.** Fain, C.C.; Robinson, G.C. (Clemson Univ., SC (USA). Dept. of Ceramic Engineering). 27 Aug 1982. Contract FG44-80R410122. 38p. NTIS, PC A03/MF A01. Order Number DE84000319.

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An effort is being made to obtain better design information at an outdoor passive solar laboratory consisting of six outdoor individual rooms with floor spaces measuring 8′ x 12′. Six houses were constructed with each one having some different design feature. The houses and their instrumentation are described and illustrated. There is a reference house of brick veneer on wood frame, a house with a red brick heat storage wall 12 inches thick, and two houses with black coated brick heat storage walls of different thicknesses. Another house has brick cavity walls in the east, north, and west walls and a red brick heat storage wall. The last house is an envelope loop house with brick cavity walls to the east, west, and north. (LEW)

376 **(DOE/R4/10123—T1) Passive-solar farmhouse.** Henderson, Z.W. (Henderson (Zachary W.), Roswell, GA (USA)). [nd]. Contract FG44-80R410123. 3p. NTIS, PC A02/MF A01. Order Number DE84000320.

Our Passive Solar Farmhouse demonstrates the applicatoin of existing conservation and renewable resource technology in a simple low cost installation. It incorporates maximizing use of our microclimate, solar orientation, passive collection, proper insulation, infiltration control, shading, natural ventilation, passive cooling and conservative off-site energy sources.

377 **(DOE/R4/10127—T1) Solar project, Covington State Area Vocational-Technical School. Quarterly report for period ending March 31, 1982.** (Covington State Area Vocational-Technical School, TN (USA)). 1982. Contract FG44-80R410127. 15p. NTIS, PC A02/MF A01. Order Number DE84000269.

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The performance of an active solar space and water heating system is reported. Also discussed is the construction of a solar air heater arranged in a honeycomb pattern using chicken wire and tin cans. (LEW)

378 **(DOE/R4/10129—T1) Solar energy narrative close-out report: Jacksonville Urban League.** (Jacksonville Urban League, Inc., FL (USA)). [nd]. Contract FG44-80R410129. 7p. NTIS, PC A02. Order Number DE84000743.

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Ten solar energy water heaters were installed by trained CETA workers. Once installed the solar water heaters were monitored. In low income communities, where the solar equipment was installed, it was found to be difficult to obtain clients and find suitable homes for the project. (LEW)

379 **(DOE/R4/10131—T1) Solar lumber kiln. Final report.** (Mad Dog Design and Construction, Inc., Tallahassee, FL (USA)). 1977. Contract FG44-80R410131. 19p. NTIS, PC A02/MF A01. Order Number DE84000748.

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The purpose of this project was to establish design parameters for the construction of small scale (1000 board foot capacity) lumber drying kiln which derives its thermal energy from the sun. Results of a six month monitoring period are presented, as well as second generation design considerations and simplified control logic. (LEW)

380 **(DOE/R4/10135—T1) Solar energy home etrofit with microcomputer-assisted optimization, control, and data collection. Final report.** deMayo, B. (DeMayo (Ben), Carrollton, GA (USA)). 31 Dec 1981. Contract FG44-80R410135. 5p. NTIS, PC A02/MF A01. Order Number DE84000814.

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A solar energy system has been designed, built and put into operation. It is basically a drain-down hot water preheater with two auxiliary storage tanks. A microcomputer monitors the system, automatically records the data, and allows the energy input into the system to be optimized. A digital flow controller was built using 4 washing machine solenoid valves. (LEW)

381 **(DOE/R4/10136—T1) Solar still. Final report.** Adams, W.D. (Adams (W.D.), Austell, GA (USA)). 20 Jul 1983. Contract FG44-80R410136. 8p. NTIS, PC A02/MF A01. Order Number DE84000773.

Handwritten manuscript.

Passive solar heating was used in a still in which a packed column packed with popped popcorn separates the alcohol and water vapors. The still's performance was not satisfactory, and it is concluded that passive solar heating could have been better used to preheat makeup water for the fermentation process and to maintain proper fermentation temperatures during the winter. (LEW)

382 **(DOE/R4/10140—T1) Passive-solar greenhouse.** (Four Leaf Farm, Durham, NC (USA)). 1982. Contract FG44-80R410140. 16p. NTIS, PC A02/MF A01. Order Number DE84000388.

Our project objective was to design, construct, and operate a commercialized (16′ x 50′) passive, solar greenhouse. The structure was originally intended as a vegetable forcing facility to produce vegetable crops in the off-season. Building and size constraints and economic considerations convinced us to use the greenhouse for producing bedding plants and vegetable starts in the spring, high value vegetables (tomatoes, cucumbers) in the fall and forced bulbs in the winter. This crop sequence allows us to use the greenhouse all year without additional heat as the crops are adopted to the temperature regime of the greenhouse during each particular season. In our first season, the greenhouse performed beautifully. The lowest temperature recorded was 38°F after 4 cold, cloudy days in February. The production of bedding plants has allowed us to diversify our products and the early transplants we produced were a great asset to our vegetable farming operation. Although construction cost (4.57 sq. ft.) is higher than that of a conventional polyethylene-covered, quonset-type greenhouse (approx. $1.92 sq. ft.), our annual operating cost is cheaper than that of a conventional greenhouse (0.49 cents sq. ft. versus 0.67 cents sq. ft.) due to a longer usable lifetime of the structure and the elimination of heating

costs. Our structure has been toured by interested individuals, school and farm groups. We plan to publicize the structure and its advantages by promoting more visits to the site.

383 **(DOE/R4/10143—T1) TA and ECM final report.** (Home Park Community Improvement Association, Inc., Atlanta, GA (USA)). 17 Nov 1982. Contract FG44-80R410143. 7p. NTIS, PC A02/MF A01. Order Number DE84000775.

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A modest, urban bungalow-type dwelling was retrofit with weatherization and modification of an existing masonry porch to make a solarium. An energy saving of 30 to 40% was projected. (LEW)

384 **(DOE/R4/10147—T1) Two-story solar greenhouse. Final quarterly report (appropriate technology) for period ending March 31, 1980.** (John C. Campbell Folk School, Brasstown, NC (USA)). 1980. Contract FG44-80R410147. 10p. NTIS, PC A02/MF A01. Order Number DE84000283.

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Over the winter of 1981-82, greenhouse was able to sustain plant life without any additional heat. Both eatable and noneatable plants were maintained. Quantity of production was not able to be calculated due to change of personnel responsibilities. Greenhouse is well designed for both winter and summer operation. Surrounded by deciduous trees, greenhouse does not overheat in the summer (in fact, more direct sunlight would probably be beneficial). Winter heating can exceed 90°F. Although not scientifically accurate, the oil consumption for the heating of Keith House was reduced an estimated 2000 gallons (or 28%). It is impossible to credit the greenhouse with this reduction totally, since storm windows were added to the building. We are satisfied with the greenhouse both with regard to its production and energy saving capacity.

385 **(DOE/R4/10148—T1) Building and using the solar greenhouse.** (Alabama Solar Energy Center, Huntsville (USA)). [nd]. Contract FG44-80R410148. 42p. NTIS, PC A03/MF A01. Order Number DE84000758.

Thorough directions are given for planning, constructing and using a solar greenhouse attached to a house. Included is a method of calculating the savings accruing from the use of the greenhouse. (LEW)

386 **(DOE/R4/10159—T1) Passive-solar composting-toilet project. Final technical report.** (Long Branch Environmental Education Center, Inc., Leicester, NC (USA)). [nd]. Contract FG44-80R410159. 6p. NTIS, PC A02/MF A01. Order Number DE84000284.

The Long Branch Environmental Education Center, Inc. has designed, constructed, put into operation and is continuing to monitor two passive solar composting toilets, one at the Western NC Nature Center, and one at the Long Branch E.E. Center. The WNC Nature Center is a public educational and recreational facility, and the unit installed at the Long Branch Center is located in a passive solar greenhouse attached to one of the Center's staff residences, and as such, can be considered a residential installation. Each of the units was constructed in a workshop format, thus providing an educational experience for all those attending and participating. Since their construction, several thousand people have had the opportunity to examine the units, including the interpretive exhibits located in each facility. Detailed plans and blueprints have been produced of the design, black and white photos, and color photos and slides of the construction process have also been produced. A brief pamphlet has also been created and printed and is made available to the public at both installations.

387 **(DOE/R4/10215—T1) Flat mirrors to assist in home heating. Final report.** Moses, R. (Moses (Ray), Greenville, SC (USA)). [nd]. Contract FG44-80R410215. 3p. NTIS, PC A02. Order Number DE84000262.

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Three hundred square feet of mirror surface was used to direct sunlight against normally unlit walls of a 1700 ft^2 home in order to contribute to the light and heat requirements. (LEW)

388 **(DOE/R4/10224—T1) Hybrid space heating/cooling system with Trombe wall, underground venting, and assisted heat pump.** Shirley, J.W.; James, L.C.; Stevens, S.; Autry, A.N.; Nussbaum, M.; MacQueen, S.V. (Shirley (Jeff W.), Columbia, SC (USA)). 22 Jun 1983. Contract FG44-80R410224. 51p. NTIS, PC A04/MF A01. Order Number DE84000406.

Our goal was to design and monitor a hybrid solar system/ground loop which automatically assists the standard, thermostatically controlled home heating/cooling system. The input from the homeowner was limited to normal thermostat operations. During the course of the project it was determined that to effectively gather data and control the various component interactions, a micro-computer based control system would also allow the HVAC system to be optimized by simple changes to software. This flexibility in an untested concept helped us to achieve optimum system performance. Control ranged from direct solar heating and direct ground loop cooling modes, to assistance of the heat pump by both solar space and ground loop. Sensors were strategically placed to provide data on response of the Trombe wall (surface, 4 in. deep, 8 in. deep), and the ground loop (inlet, 3/4 length, outlet). Microcomputer hardware and computer programs were developed to make cost effective decisions between the various modes of operation. Although recent advances in micro-computer hardware make similar control systems more readily achievable utilizing standard components, attention to the decision making criteria will always be required.

389 **(DOE/R4/10226—T1) Workshops and incentive loans program for construction of solar greenhouses, grain dryers, window boxes and food dryers. Final performance report.** Walker, D.H. (Upper Sand Mountain Parish, Section, AL (USA)). Feb 1982. Contract FG44-80R410226. 27p. NTIS, PC A03/MF A01. Order Number DE84000759.

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A Solar Loan Fund was established to provide low-interest incentive loans to families desiring to construct their own solar devices, the only stipulations being allowance of reasonable public visitation and monitoring and employment of parish-trained construction teams if labor is to be hired. About 30 vocational agriculture students built window box collector units as part of their classroom experience, trying several designs. Later, 12 to 15 families built window box collectors for their use. A week long Energy Responsibility: Today and Tomorrow workshop was held involving construction projects and mini-seminars. Another workshop was held to construct bread box type solar hot water heaters, and yet another to build solar food dryers. (LEW)

390 **(DOE/R4/10239—T1) Homemade system for solar heating of hot water. Final report.** Johnson, G.E. (Johnson (Gus E.), Knoxville, TN (USA)). Aug 1982. Contract FG44-80R410239. 2p. NTIS, PC A02/MF A01. Order Number DE84000671.

A basic homemade system for solar heating of hot water was constructed, including a homemade solar collector, self-priming pump, and electrical components. Collector efficiency is reported to be poor. (LEW)

391 **(DOE/R4/10244—T1) Demonstration of energy-conserving techniques for retrofitting commercial greenhouses.** (Whitehead (Nancy L.), Strawberry Plains, TN (USA)). [nd]. Contract FG44-80R410244. 8p. NTIS, PC A02/MF A01. Order Number DE84000665.

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Curiously, although all commercial greenhouses receive abundant solar radiation daily, they are not solar reliant. No attempt is made to capture, store, or conserve the potential solar heat. Instead, most excess heat is simply vented to the outside and is lost. Then, when the greenhouse later needs heat, it is artificially supplied by burning fossil fuel. With the average commercial greenhouse using ten (10) times the energy per square foot required to heat a well insulated home, any attempt to utilize solar heating techniques promises to not only save fossil fuel but save an important state industry from decline. Many commercial operators, facing ever increasing energy costs, feel they may not be able to remain in

business. Using simple passive solar heating techniques, a commercial greenhouse was retrofitted to make it more solar reliant. To conserve energy, the east, west, and north walls were insulated with two inch painted plastic foam insulation. One hundred and twenty black painted water-filled steel drums were used inside the structure to capture and store solar radiation. Two other commercial greenhouses of identical size, orientation, and temperature level were used to give side by side comparison to the solar retrofitted structure. The three greenhouses were monitored daily for temperature and effect on plant growth or rate of flowering. No adverse effects were found due to diminished lighting from the north wall insulation during the test period. Energy savings were impressive, the solar reliant structure using 46% less fuel oil during the 12 week test period. As a result, the owner of the commercial operation where the test was conducted is converting all his quonset style greenhouses to solar reliant design.

392 **(DOE/R4/10255—T1) Low-cost solar room kit. Final grant report.** (Dahl (Kathy), Winchester, KY (USA)). [nd]. Contract FG44-80R410255. 14p. NTIS, PC A02/MF A01. Order Number DE84000378.

A low cost solar room kit was developed which would make use of local framing materials, but provide inexperienced builders with a simple joining system and materials - such as glazings - not usually available in local stores. Since solar room applications are proven effective in providing supplementary home heat, a kit would make solar heat more accessible to home owners and tenants. Although a prototype and two working models of the kit were successfully built, commercial development cannot occur until problems in matching the glazing and framing system can be resolved, and more capital to lower production costs on the framing union pieces is available.

393 **(DOE/R4/10256—T1) Multi-faceted energy-conservation program. Final technical report.** (Edmonson County Public Library, Brownsville, KY (USA)). 1981. Contract FG44-80R410256. 17p. NTIS, PC A02/MF A01. Order Number DE84000765.

The purpose of this project was to design and build 19 solar thermosiphoning air panels, insulate walls, generally tighten up the library building, and install other energy conserving devices. Another purpose of the project was to serve as a model to other libraries in Kentucky, to commercial buildings in this area, and to homeowners in the area. After much discussion with architects and among ourselves, we chose a type of solar installation that would be visible to the public and easily replicated. We also carried out a number of procedures to make the library building more energy efficient: installed a 7-day programmable setback thermostat; insulated the walls; improved weatherstripping around the doors; added an economizer control to our air-handling system; and put an electric damper controlling supply air to a large but intermittently usedmeeting room. These changes resulted in approximately $700 in savings from December 1981, through February 1982. Thus far, we have carried out public education with a sign, brochures, press releases, and the purchase of appropriate books; librarians have received our brochure, and some have attended a workshop given here on energy conservation and solar energy.

394 **(DOE/R4/10263—T1) Design, installation, and monitorig of a water-preheat system for coin laundries.** Cloud, N.E. (Cloud (Nolan E.), Winterville, GA (USA)). [nd]. Contract FG44-80R410263. 7p. NTIS, PC A02/MF A01. Order Number DE84000780.

This project involved the design, installation, and monitoring of a water-preheat system for coin laundries. The system has two components. One component is solar, the other is waste heat reclamation from the clothes dryer exhaust. The energy savings achieved amount to roughly 50% of the total water heating load for a typical coin laundry.

395 **(DOE/R4/10275—T1) Optimizing passive-solar-water-heater performance. Final report.** Cash, L. (Cash (Lee), Atlanta, GA (USA)). Nov 1982. Contract FG44-80R410275. 38p. NTIS, PC A03/MF A01. Order Number DE84000787.

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This study reports the findings of an optical analysis of various reflector augmentation techniques for passive solar water heaters. Based on the optical analysis an internal CPC reflector system was tested that yielded 61% efficiency on water drawn 8-1/2 hours past noon in October. Based on analysis of empirical and construction data additional low cost refinements are made and related to a component classification system.

396 **(DOE/R4/10276—T1) Construction of fourteen (14) low-cost passive-solar-energy system in low-income neighborhoods. Final technical report.** (Goodwill Industries of Atlanta, Inc., GA (USA)). 22 Feb 1982. Contract FG44-80R410276. 60p. NTIS, PC A04/MF A01. Order Number DE84000788.

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A total of ten passive solar energy systems including five (5) breadbox water heaters and five solar greenhouses were produced and installed by Goodwill's solar project on pre-selected homes in Atlanta neighborhoods. It should be noted that due to budget cuts in Goodwill's solar project, the Georiga Solar Coalition and the DeKalb Economic Opportunity Authority assisted the project late during its contract period. Both organizations compensated for these budget reductions by providing necessary volunteer labor and technical expertise in the design, production and installation of two breadbox water heaters and two solar greenhouses. Goodwill produced and installed three breadbox water heaters and three solar greenhouses. The project was unable to identify the remaining four recipient dwellings before the end of the projects contract period however the Georgia Coalition currently has sufficient inventory to retrofit several homes with breadbox water heaters and the DeKalb Economic Opportunity Authority has sufficient inventory to convert at least ten porches to solar greenhouses.

397 **(DOE/R4/10295—T1) Passive-solar-heating project for a single-family residence. Final report.** Starkey, V.J. (Starkey (Vonley J.), Kissimmee, FL (USA)). 1 May 1982. Contract FG44-80R410295. 6p. NTIS, PC A02/MF A01. Order Number DE84000409.

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This project was a passive home heating system utilizing solar collectors that are part of the roof structure of a 15′ x 30′ greenhouse. The design utilized solar air collectors constructed on site that are actually part of the roof of the greenhouse. The flow of air is from the storage to the collectors then back to the storage. The storage bin consists of a 5′ x 19′ concrete insulated bin built into the floor of the greenhouse. The storage mass was gallon plastic jugs. The plastic jugs did not work properly, so they are being replaced by salt rods. This replacement will be an after the fact project by the owner. The concrete storage bin was insulated with 2″ plastic foam insulation, applied to the 8″ concrete wall. The ducts entering and leaving the storage bin have low voltage (12 volt) electric dampers. A cross flow system was used. The heated air circulates from the collectors to storage via ducts in the walls of the lean-to design. The removal of heat from the storage bin was from end to end via the ducts to the central air system for the house. In addition, the greenhouse is connected to the house with a doorway that can be opened to circulate air into the house, a shuttled exhaust fan 1/3H.P. motor has aided in the circulation of air from the storage bin to the collectors and back.

398 **(DOE/R4/10297—T1) Solar collector/still for salt-water desalination. Final report.** Fonash, R.L. (Fonash (Raymond L.), Little Torch Key, FL (USA)). [nd]. Contract FG44-80R410297. 10p. NTIS, PC A02/MF A01. Order Number DE84000407.

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A combined in-line solar collector/still for the desalination of salt water was designed, built, and tested on site in the Florida Keys. During the course of the project the basic configuration was modified, as project funds permitted, to enhance performance. This collector/still utilizes sunlight for the direct heating of water and for the heating of air. The heating air is bubbled through the heated water producing desalinated water vapor which is subsequently collected. The result is non-salted water produced using sunlight.

399 **(DOE/R4/10303—T1) Underground home A/C system. Final report.** Outland, B.W. (Outland (B.W.), Pensacola, FL (USA)). 30 Jun 1981. Contract FG44-80R410303. 10p. NTIS, PC A02/MF A01. Order Number DE84000416.

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The purpose of the project was to transfer the heat of house air into the earth through an underground piping system, return the cooler to the house and disperse it throughout the house. The principle of the idea has been achieved, but not to the extent desired. It was originally hoped that the system would allow temperatures in the house to reach a maximum of 80° even during days where outside temperatures reached high 90°. So far, a differential of 6° to 8° has been achieved.

400 **(DOE/R4/10306—T1) Solar-powered cooling system. Final technical report.** DeGeus, A.M. (S.R.D. Corp., Eastover, SC (USA)). 1981. Contract FG44-80R410306. 25p. NTIS, PC A02/MF A01. Order Number DE84000700.

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A solar cooling system was developed which includes 5 concentrating parabolic solar collectors and is characterized by the elimination of compressors and pumps by letting the solar heat compress the refrigerant. System performance is described as well as economics compared with conventional cooling systems and other solar cooling systems. (LEW)

401 **(DOE/R4/10312—T1) Urban alternative homestead.** (Environmental Alternatives, Inc., Louisville, KY (USA)). 1980. Contract FG44-80R410312. 14p. NTIS, PC A02/MF A01. Order Number DE84000774.

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The three main areas of work were in redesigning and correcting the design flaws of the active heating system, the passive solar heating system, and the furnace controls, so that the building would heat and cool itself more efficiently and evenly than it had before. The active system was re-plumbed, fixing leaks, and adding joints and parts needed to work properly. Its tanks were insulated and new pumps installed. The passive system was reworked by adding a shadescreen to the outside of the greenhouse for summer cooling, and by adding ductwork to remove excess heat from the greenhouse and office, and redistribute it to the rest of the building, or to the outside. To help heat the north rooms, this recycled heat was very helpful. Also, insulating the floor under the north rooms was very helpful in providing more even heating. In order for the heating system to operate more efficiently, the electronic controls had to be reworked so the proper messages could be sent to the furnace about when to use each kind of heat. The lowered gas usage of the house told the story about how much better the active and passive systems were when the grant was completed. Moreover, the house was much more comfortable, not only from the overheating in the summer, but from a more even distribution of the heat to the north rooms. The fact that the electrical usage increased reflected the fact that the new pumps took more electricity to run them, and that the active system did not have all of the flaws worked out.

402 **(DOE/R4/10313—T1) Use of solar energy in the production of channel catfish. Final report.** Cox, G.C. (Morehead State Univ., KY (USA)). 1976. Contract FG44-80R410313. 27p. NTIS, PC A03/MF A01. Order Number DE84000435.

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No catfish are grown commercially in eastern Kentucky due primarily to a growing season approximately three weeks too short to provide the minimum 180 day feeding season. This research project was designed to test the feasibility of using solar energy to heat pond water enough to lengthen the feeding season the required number of days. The procedure involved the heating of a small starter pond by covering it with a solar swimming pool cover. Fingerling catfish were stocked in the small pond in early April and transferred to a larger rearing pond in May when water temperatures in the larger pond reached 65° F. Oxygen levels were maintained at acceptable levels in the covered pond by frequent aeration. Water quality resulting from a prolonged spring drought and run-off from a pasture fertilized by chicken manure seriously affected the project. Other significant problems encountered included algae build-up and the accumulation ammonia and carbon dioxide in the water. Losses to fungus infection was the most serious problem encountered. Approximately 30 percent of the fingerlings died from this cause while in the small covered pond. After the fish were transferred to the large rearing pond, no further unanticipated problems were encountered. From the time the fish were transferred to the large pond they were handled in a typical open pond operation. At the end of the growing season in October, the fish had an average weight of 1.4 pounds.

403 **(DOE/R4/10314—T1) Thermal-envelop stone house, solar. Final technical report.** Avery, S.C. (Avery (Samuel C.), Upton, KY (USA)). 19 May 1982. Contract FG44-80R410314. 12p. NTIS, PC A02/MF A01. Order Number DE84000766.

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The purpose of this project is to create a comfortable, low-cost heating system for a single-family house, without dependence on non-renewable energy sources. I have attempted to combine a simple solar air-heating collector with the thermal envelop concept (for thermal air circulation) and massive interior stone walls for heat storage. All building materials, with the exception of the solar glazing material and certain other solar components, are inexpensive and locally produced. Examples are: rough-cut hardwood lumber, sandstone (free for the gathering), galvanized roofing for absorberplate, concrete, concrete block, and cellulose insulation. The collector has operated with a relatively high degree of efficiency, though three 0.6 amp duct fans had to be installed in order to increase air circulation. The interior stonework has provided more than adequate heat storage, along with even heat radiation throughout cloudy periods. My main problem has been heat loss around the foundation.

404 **(DOE/R4/10444—T1) Tilapia culture in conjunction with irrigation and urban farming. Final report.** Bondari, K.; Threadgill, E.D.; Bender, J.A. (Morehouse Coll., Atlanta, GA (USA); Georgia Univ., Tifton (USA). Georgia Coastal Plain Experiment Station). May 1983. Contract FG44-81R410444. 13p. NTIS, PC A02/MF A01. Order Number DE84000793.

This study involved 2 experiments. Exp. I was designed to determine the potential use of tilapia culture (Tilapia aurea) incorporated into an integrated irrigation system capable of (1) removing algae and other aquatic plants from the pond water by feeding, and (2) providing some resource recovery through growth and reproduction. Exp. II was conducted to determine the potential use of blue tilapia in urban farming. Facilities included a passive solar greenhouse attached to a renovated residential house, an indoor pond located in the greenhouse for overwintering tilapia, and an outdoor pond for the summer growth.

405 **(DOE/R4/10461—T1) Passive-solar techniques for the mobile/modular housing industry.** Osborn, D.C. (Osborn (Daniel C.), Huntsville, AL (USA)). 31 Jan 1983. Contract FG44-81R410461. 47p. NTIS, PC A03/MF A01. Order Number DE84000738.

Using a fairly typical mobile home design, it is shown that state-of-the-art mobile/modular housing and passive solar techniques can be used together. Computer simulations are used to analyze the concept. Size conditions at a mobile home park are considered. Glazing orientation, shading, and thermal storage are included in the analysis. (LEW)

406 **(DOE/R4/10464—T1) Developing proto-type pump which would utilize unique thermo-dynamic cycle. Final report.** (Largo Solar Systems, Inc., Plantation, FL (USA)). 1983. Contract FG44-81R410464. 44p. NTIS, PC A03/MF A01. Order Number DE84000323.

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The work described was to develop a prototype pump working on the thermosyphon principle and useful as a circulating device for a solar domestic hot water system. Numerous photographs and drawings illustrate the device. (LEW)

407 **(DOE/R4/10479—T1) Solar-heated commercial-greenhouse demonstration. Final performance report.** (Poly Solar Co., Lincolnton, NC (USA)). [nd]. Contract FG44-81R410479. 15p. NTIS, PC A02/MF A01. Order Number DE84000379.

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Poly Solar Company was formed to design and fabricate a demonstration of a solar heating system for commercial greenhouses in moderate climates. This system is built of readily available materials, and can be constructed using conventional techniques available to most builders and farmers. Construction began on the demonstration project in August 1981 and the system was placed into operation that winter. Energy savings were calculated by monitoring the running time on an oil furnace in a duplicate greenhouse with the same crop as the solar heated greenhouse with an oil backup furnace. The first monitoring period was before the Christmas season with poinsettias used as the comparison crop with 60° to 64°F. During this period the 126 ton mass storage and waste heat recovery sections of the system were used. These trials showed energy savings over the 100% oil heated structure to be 23.4%. After the crops were removed from the greenhouse trials were ran which showed this portion of the system could maintain night time temperatures as high as 56°F with no other heat source and an outside temperature of 26°F. The 1860 sq ft solar collector/storage system was monitored with a winter-spring crop of geraniums at a night time temperature of 60° to 64°F. In April 1982 a severe storm with wind gusts in excess of 50 mph destroyed a section of duct that feeds heated air from the collector to the rock storage bed and caused light damage to the collector itself.

408 **(DOE/R4/10491—T2) Conversion of administration buildings entry to a greenhouse. Final status report.** Nolan, A.H. (Nolan (Algin H.), Mt. Sterling, KY (USA)). 9 Aug 1982. Contract FG44-81R410491. 9p. NTIS, PC A02/MF A01. Order Number DE84000772.

A project is briefly described that was to convert an administration building's entry to a greenhouse. The plan calls for extra insulation, a Trombe wall, berming, and double-glazed window units. The social and economic benefits of the project and qualifications of key people are listed. (LEW)

409 **(DOE/R4/10493—T1) Innovative conservation housing. Final progress report.** Nuttle, D.A. (Nuttle (David A.), Raleigh, NC (USA)). 1983. Contract FG44-81R410493. 38p. NTIS, PC A03/MF A01. Order Number DE84000381.

A new passive solar thermal storage brick was developed and tested. A new insulating curtain concept was developed to assist in passive solar heating and cooling. A steel truss was designed to replace the wood truss in solar attic applications where the wood truss typically suffers some 50% loss of structural strength. Improvements were made of the dry composting toilet and grey water recycling for homes. An algae cultivation system was created for production of food, feed, fertilizer, or biomass as needed for home, farm, or industry. New concepts were explored in the areas of economy shelter, solar hot water heating, home generation of electricity, edible landscapes and other home food production, growing of fiber crops for cottage industry, storage, insulation, solar cooking, and solar refrigeration. (LEW)

410 **(DOE/R4/10494—T1) Solar greenhouse for Sunflower Public Library, Sunflower, Mississippi. Final report.** (Sunflower County Library, Indianola, MS (USA)). [nd]. Contract FG44-81R410494. 6p. NTIS, PC A02/MF A01. Order Number DE84000318.

The Sunflower County Library constructed a solar greenhouse to enhance the energy-saving features of the new portable library in the Town of Sunflower. Although the building was designed to include many passive solar features, we felt its energy efficiency would be greatly improved by the addition of an entry-lock solar greenhouse. According to the original plan the door opened directly to the outside. During very cold or hot weather, simply opening the door would allow the expensively heated or cooled air to escape. In addition, we wished to retain as much heat as possible through the use of water filled storage containers. The greenhouse area would provide the necessary space.

411 **(DOE/R4/10505—T1) Passive-solar-heated firehouse. Final project performance report.** (Hollingsworth Volunteer Fire Dept., Alto, GA (USA)). 1 Mar 1983. Contract FG44-81R410505. 10p. NTIS, PC A02. Order Number DE84000714.

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Although normally uninhabited, a volunteer fire department's engine house must be kept above freezing temperatures to prevent equipment damage and to enable easy starting of engines when called in an emergency. Conventional sources of energy for heating are too costly for a gift-funded department, so the building must maintain a usable temperature at little or no energy cost. The Hollingsworth Volunteer Fire Department, Banks County, Georgia, received funds to upgrade an existing firehouse of passive solar design and monitor the building's performance during the winter of 1981-82. Use of the water stored in the two trucks' tanks for heat storage proved successful, as heating costs were minimal during a normal winter.

412 **(FRNC-TH—1155) Experimental study of a new solar distillation apparatus, spherical sweep distillation apparatus.** Makki, A. (Lyon-1 Univ., 69 (France)). 1981. 174p. (In French). NTIS (US Sales Only), PC A08. Order Number DE84750129.

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This report studies the new solar distillation apparatus and its comparison with the flat conventional one. It begins with a comparative study of the various desalination processes with respect to energy consumption. The study of both flat and spherical types of apparatus makes it possible to establish a general form for the operating equations of a solar distillation apparatus of any type, evaluate the various energy fractions which come into play and the heat losses through the opaque walls as well as the exchange coefficients, elaborate a new expression of the overall efficiency, calculate the effective flux received by the water in the tank and the shadow areas of a distillation apparatus and highlight the condensation and sweep effect, as well as the inertia of the apparatus. The comparison of these two types of apparatus has shown that the spherical apparatus has a better production, that its thermal inertia is much less than that of the type and that its shadow areas much less. The experimental method followed and the results achieved are described. Even if the performance of a flat apparatus is improved by using low inertia materials, transparent walls, a "windscreen" wiper, etc., the spherical apparatus retains the advantages for ease of manufacture and use, greater surface condensation, transmitted flux and reduced useless losses through the walls.

413 **(N—8323750) Active and passive systems for solar housing.** Schneider, M. (Centre National de la Recherche Scientifique, Valbonne (France)). Nov 1982. 2p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 43-44 (SEE N83-23743 13-44).

After a description of the bioclimatic house, the various solutions for passive, active, and integrated solar houses are described.

414 **(N—8323751) Heat pumps.** Gilli, P.V. (Technische Univ., Graz (Austria)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources Potential p 47-52 (SEE N83-23743 13-44).

Heat pumps for residential/commercial space heating and hot tap water make use of free energy of direct or indirect solar heat and save from about 40 to about 70 percent of energy if compared to a conventional heating system with the same energy basis. In addition, the electrically driven compressor heat pump is able to substitute between 40% (bivalent alternative operation) to 100% (monovalent operation) of the fuel oil of an oilfired heating furnace. For average Central European conditions, solar space heating sys-

tems with high solar coverage factor show the following sequence of increasing cost effectiveness: pure solar systems (without heat pumps), heat pump assisted solar systems, solar assisted heat pump systems, subsoil/water heat pumps, air/water heat pumps, air/air heat pumps.

415 **(N—8323771) Workshop 1: Passive solar systems.** Schneider, M.; Schreitmueller, K.R. (Centre National de la Recherche Scientifique, Valbonne (France)). Nov 1982. 8p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 207-214 (SEE N83-23743 13-44).

The design of a solar house for a latitude of 50 degrees north in Northern Europe is discussed. An evaluation of a 500 cubic meter house and a computerized simulation of a 350 cubic meter house are given. It was found that the heating demand of a poorly insulated house may be decreased by 70 to 75% by means of extensive insulation. New buildings should be extensively insulated, passive solar energy utilization is usually not cost effective.

416 **(N—8323772) Workshop 2: Optimization of solar heating systems.** Bruck, M. (Austrian Solar and Space Agency, Vienna). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In Solar Energy 1982: Resources, Technol., Potential p 215-220 (SEE N83-23743 13-44).

The life cycle cost method was used to investigate the solar domestic hot water preparation economic sensitivity in Austria, the Federal Republic of Germany and France. The life cycle savings of a solar heating system over a conventional heating system are expressed as the difference between a reduction of conventional fuel costs and an increase in expenses incurred as a result of the additional investment for the collector system.

417 **(N—8323791) Characteristics of exhaust air facades as solar absorbers for saving of heating energy. Final Report, Oct. 1981.** Voncube, H.L.; Ludwig, E. (Cube Ingenieurunion G.m.b.H., Worms (Germany, F.R.)). Dec 1982. 206p. (In several languages). (BMFT-FB-T—82-245; ISSN—0340-7608). NTIS, PC A10/MF A01.

Bundesministerium fuer Forschung und Technologie.

The solar radiation exploited by solar exhaust air windows was measured at a building facing four main directions. The windows were not constructed as optimal radiation absorbers and the heat gain stood in a range of 3 to 10% of the heat consumption, depending on time of year. Optimal windows (chiefly clear glass with Venetian blinds) were found by a computer program simulating the process of radiation in an exhaust air-window. Heat gains up to 50% can be obtained and the relation to air flow rate and others were found. The calculated results were proved by measurements. With a suitable heating systems in the building (heat transport from south side to north side, heat storage) up to 50% of the annual consumption can be saved.

418 **(NP—4900251) Residential conservation demonstration program: domestic hot water.** Merrigan, T. (Florida Solar Energy Center, Cape Canaveral (USA)). 1982. 31p. Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL.

Four types of domestic hot water (DHW) systems installed in 80 homes throughout Florida are currently monitored by the Florida Solar Energy Center (FSEC) under a demonstration program for the Florida Public Service Commission. DHW systems selected for the program are located in four major population areas of Florida: Jacksonville, Orlando/Brevard County, North Palm Beach/Ft. Lauderdale, and the Tampa Bay region. Twenty systems of each DHW type - conventional electric water heaters, heat pump water heaters, solar hot water systems, and waste heat recovery units - are metered to determine electricity use and hot water energy production. A microcomputer-based data acquisition system collects 15-minute interval data at each site and returns it to FSEC over the telephone network semi-weekly. The data is analyzed to determine the average system efficiency and the time-of-day water and electricity demand profiles. Analysis for the Florida warm season of 1982 indicates that the solar systems and heat recovery units operated with the highest efficiency while the heat pumps performed approximately twice as efficiently as the conventional electric water heaters. The average electrical demand profiles of the solar and heat recovery groups were considerably lower than those for the conventional and heat pump water heaters. The profiles of the latter two systems were similar although the heat pump sample used more hot water than the conventional group. When completed in 1983, the study data will provide a full year comparison of the energy savings and time-of-day impact of each DHW system type.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 350, 359, 705

419 **(DOE/R4/10077—T1) Heat pipe dynamics. Final report, April 30, 1981.** Norman, R.M. Sr. (Norman (Rayford M., Sr.), Huntsville, AL (USA)). 1981. Contract FG44-80R410077. 15p. NTIS, PC A02/MF A01. Order Number DE84000761.

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A heat-pipe flat plate solar collector is constructed like a typical flat plate collector with the exception that individual heat pipes are attached to the collector surface to transfer collected heat via a phase change from collector surface into an attached jacket containing a phase change material. The efficiency of such a collector was measured roughly. Also briefly described are: a heat-pipe heat exchanger, heat-pipe heat exchanger freeze proofing, heat-pipe attic ventilation, transfer of light bulb heat via a heat pipe to heat water, heat recovery via heat pipe, cooling of oil in engines and transmissions via heat pipe, a tracking reflector, automatic sun tracker, single-stroke vacuum pump for heat-pipe manufacture, and heat pipe heat transfer from rock bed. (LEW)

420 **(DOE/R4/10091—T1) Solar collector panels (process-method). Rainwater collection and storage.** Mowery, J.W. (Mowery (James W.), Oldsmar, FL (USA)). 15 Oct 1981. Contract FG44-80R410091. 34p. NTIS, PC A03/MF A01. Order Number DE84000737.

A process for producing panels for solar heating of potable water is described. The panels have PVC tubing flat-coiled into square or rectangular shapes. Also described is a cistern for collecting and storing rainwater. (LEW)

421 **(DOE/R4/10108—T1) Plans for solar window-box heat collector: Mississippi Solar Council project.** (Mississippi Solar Co., Jackson (USA)). [nd]. Contract FG44-80R410108. 12p. NTIS, PC A02/MF A01. Order Number DE84000263.

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Plans and assembly instructions are given for a home-made solar air heaer that uses corrugated sheet to absorb solar radiation and channel air flow. The unit is placed in a south-facing window at an angle of about 45°, and is designed to pull sinking cool air out of the room, warm the air, and push the warmed air back into the room. When the plates are not heated above room temperature by the sun, the cooler air at the bottom of the collector is said to prevent cold air from entering the room. (LEW)

422 **(DOE/R4/10117—T1) Solar water heater - multiple function. Final report, January 1, 1980-March 31, 1981.** (SOLARFAB, Cary, NC (USA)). 1981. Contract FG44-80R410117. 11p. NTIS, PC A02/MF A01. Order Number DE84000286.

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Sixteen full scale prototypes of water-based solar collectors were constructed and tested. Flat and corrugated sheets were used. Several small scale models were made to test alternative means of fastening two sheets together to form a fluid reservoir and to absorb solar radiation. All prototypes consisted of a black top absorber plate. (LEW)

423 **(DOE/R4/10205—T1) Low-cost retractable solar collector.** (Strubble (V.), Raleigh, NC (USA)). Jan 1982. Contract FG44-80R410205. 27p. NTIS, PC A03/MF A01. Order Number DE84000280.

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The purpose of this grant was to develop a low cost, daytime assistive heating device which is easy to install, aesthetically appealing and retractable in the off-season. I believe this concept could be further developed and prove to be a very useful tool in the conservation of energy. In areas where there is a need for daytime heat this device if properly developed would prove to be more beneficial than storm windows and cost less to install. Initial research came up with the idea of a solar collector being flexible. The idea is a bag that can be rolled up and stored in its own structure. To be low cost it was made of polyethylene and the bag is hung from the eves of a house and can be stored in eves. The bag has a black back and clear front. Attaching an air system to it as simply as possible was done by opening a vent at the bottom of the bag and going directly into the building and then doing the same at the top of the bag except the air would be carried through the attic to a more north side of the building. A detailed explanation of the original purposal is available with the grant. The rest of this report will relate to changes and results since that original plan was written.

424 **(DOE/R4/10294—T1) Low-cost solar collector test and evaluation. Final report.** Benjamin, C.M. (Benjamin (Charles M.), Cocoa Beach, FL (USA)). [nd]. Contract FG44-80R410294. 10p. NTIS, PC A02/MF A01. Order Number DE84000408.

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Project was to test and evaluate a highly efficient low cost solar collector and to make this technology available to the average homeowner. The basic collector design was for use in mass production, so approximately forty collector panels were made for testing and to make it simple to be hand built. The collectors performed better than expected and written and visual material was prepared to make construction easier for a first time builder. Publicity was generated to make public aware of benefits with stories by Associated Press and in publications like Popular Science.

425 **(N—8323759) Concentrating photovoltaic systems.** Dupas, A. (Centre National d'Etudes Spatiales, 75 - Paris (France)). Nov 1982. 9p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 113-121 (SEE N83-23743 13-44).

Various configurations for concentrating photovoltaic systems are described and their operating principles are explained. The effects of temperature and series resistance on system efficiency are discussed. As an example, the french family of photovoltaic concentrating systems, SOPHOCLE, is described. The SOPHOCLE family of generators is characterized by the use of a heliostat with altazimuth mounting and by the choice of medium concentration (C 45) by fresnel lenses on silicon cells.

426 **(SAND—82-1040) Structural analysis of a glass/space frame parabolic-trough solar collector for various operating positions.** Koteras, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01. Order Number DE84001137.

A study has been carried out to determine the stresses due to gravity in the reflective panels of a parabolic-trough solar collector for various operating positions. Combined wind and gravity loads are considered for one of the operating positions. The reflective panels which make up the troughs use glass as the reflecting medium and also as the major structural component. To determine the stresses, a finite element model was constructed for a collector string. Stresses were computed at four different operating positions. The maximum and miminum stresses do not show, for the most part, large variations for the various operating positions. The stress results for this particular design show that it should survive wind and gravity loads for all of its operating positions. A discussion is presented regarding analyses of the panel design as it evolved. These analyses indicated that, for a particular design, the basic geometry is the driving force for determining the overall stress pattern and the magnitudes of the stresses.

427 **(SERI/TP—253-2106) Advanced concentrator research: two examples.** Murphy, L.M. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1983. Contract AC02-83CH10093. 9p. (CONF-830990—1). NTIS, PC A02/MF A01. Order Number DE84000015.

From Solar thermal research workshop; Atlanta, GA, USA (7 Sep 1983).

This paper briefly describes the major research efforts and findings at the Solar Energy Research Institute (SERI) on two innovative, potentially low-cost, concentrator concepts. The first concept discussed is the stretched-membrane heliostat, and the second is the polymer-enclosed parabolic dish.

428 **Guiding device for radiation energy.** Winston, R. (to Dept. of Energy, Washington, DC (USA)). German(FRG) Patent 2,938,942/A/. 26 Sep 1978. 19p. (In German).

US PAT-APPL-945812.

The radiation energy collector for solar radiation that may be used as a concentration device of the second stage has got an energy converter and reflecting walls. The walls are arranged along a flow line of the geometric vector flux. By this means a converter is produced acting as an incoherent Lambert radiation energy emitter with a finite dimension. Through shaped as well as cone-type guiding devices were developed.

1420 Heat Storage

429 **(FRNC-TH—1159) Transfer of energy and water with hysterisis in nonsaturated ground above a solar energy storage.** Guiraud-Sales, M.T. (Montpellier-2 Univ., 34 (France)). 1981. 138p. (In French). NTIS (US Sales Only), PC A07. Order Number DE84750127.

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The work presented in this report is a contribution to the study of mass and energy transfers in the layer of non saturated soil located above a solar energy storage area. A modelisation is necessary in order to evaluate the fields of water content, temperature and capillary suction, and the losses of calorific energy by this superficial layer. The model used is taken from the general model of non saturated porous environments. This model is completed by taking hysterisis phenomena into account. The equations of the model are put into non-dimensional form, linearized and discretized by the finite differences. The numerical model is then applied to the study of the unidirectional transfers of mass and energy in a non saturated horizon located above a heat storage area. The calculation programme indicates the change in the outlines of the apparent specific volume of the water, the temperature and the capillary suction during the various calculation stages. The temperature outlines in the soil layer are virtually linear. From the practical angle this enables the temperature gradient to be evaluated very easily and the calorific energy losses to be deduced from it.

430 **(N—8323752) Solar energy and storage.** Kesselring, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 53-58 (SEE N83-23743 13-44).

The contribution consists of two parts. The first one deals with the problem that substituting oil by solar energy also implies finding a long term storage for high quality energy. The conclusion of the rather general discussion is that solar high temperature chemistry, electrochemistry and photochemistry are probably the most important research and development fields to be emphasized in the future. In the second part work done at EIR is presented. The topics sketched are remarks concerning underground heat storage, capacity determination for medium term (days to weeks) hot

water storages, the energy density in latent heat storage and a few remarks to the problem of using the grid to store (or buffer) solar (photovoltaic) electricity.

431 **(PB—83-241992) Draft recommendations for a European reporting format on the performance of solar heat stores. Final report.** den Ouden, C. (Commission of the European Communities, Luxembourg). [nd]. 135p. (EUR—8218-EN). NTIS, PC E07/MF E07.

It has been recommended that a reporting format be devised in order to provide a more uniform means of presenting results of experimental work. Three formats are presented: (1) latent heat storage in phase change materials; (2) latent heat storage in adsorbing materials, and (3) seasonal heat storage.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

432 **(DOE/ET/27196—T13) Imperial County geothermal development quarterly report, July 1-September 30, 1983.** (Imperial, County of, El Centro, CA (USA). Dept. of Public Works). Oct 1983. Contract FC03-79ET27196. 8p. NTIS, PC A02/MF A01. Order Number DE84002006.

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The highlights of geothermal development in Imperial County during July, August, and September 1983 are discussed. Topics include the status of geothermal development projects in the county, geothermal staff activities and research projects, and other geothermal-related topics.

1502 Geology And Hydrology Of Geothermal Systems

433 **(LBL—16100) Summary of modeling studies of the Krafla geothermal field, Iceland.** Bodvarsson, G.S.; Pruess, K.; Stefansson, V.; Eliasson, E.T. (Lawrence Berkeley Lab., CA (USA); National Energy Authority (Iceland); State Electric Power Works, Reykjavik (Iceland)). Aug 1983. Contract AC03-76SF00098. 10p. (CONF-831041—11). NTIS, PC A02/MF A01. Order Number DE84000939.

From 1983 Geothermal Resources Council's annual meeting; Portland, OR, USA (24 Oct 1983).

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A comprehensive modeling study of the Krafla geothermal field in Iceland has been carried out. The study consists of four tasks: the analysis of well test data, modeling of the natural state of the field, the determination of the generating capability of the field, and modeling of well performance. The results of all four tasks are consistent with field observations.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 447, 448, 449, 450, 452

434 **(DOE/ET/11395—18) Geopressured-geothermal aquifers. Final contract report.** (Scientific Software-Intercomp, Sugar Land, TX (USA)). Aug 1983. Contract AC08-78ET11395. 181p. NTIS, PC A09/MF A01. Order Number DE84001145.

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Task 1 is to provide petrophysical and reservoir analysis of wells drilled into geopressured-geothermal aquifers containing dissolved methane. The list of Design Wells and Wells of Opportunity analyzed: Fairfax Foster Sutter No. 2 (WOO), Pleasant Bayou No. 2 (Design), Amoco Fee No. 1 (Design), G.M. Koelemay No. 1 (WOO), Gladys McCall No. 1 (Design), P.R. Girouard No. 1 (WOO), and Crown Zellerbach No. 2 (WOO). Petrophysical and reservoir analysis of the above wells were performed based on availability of data. The analysis performed on each well, the assumptions made during simulation, and conclusions reached.

435 **(DOE/ET/28462—1) Effect of pore pressure on the elastic moduli, porosity and permeability of Berea sandstone and Leuders limestone.** Thompson, T.W.; Kelkar, S.M.; Gray, K.E. (Texas Univ., Austin (USA). Coll. of Engineering). Feb 1983. Contract AS05-77ET28462. 162p. NTIS, PC A08/MF A01. Order Number DE83007019.

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The behavior of Berea sandstone and Leuders limestone under atmospheric and elevated pore pressures is reported. The porosity and the permeability changes, along with the static and dynamic moduli for these rocks have been determined under various conditions. The existing theoretical background pertinent to the study is reviewed along with the previous experimental work. The detailed descriptions and the discussions on the experimental procedure involved and the equipment utilized are presented. A discussion on the sources of experimental errors is included. It also includes the error propagation equations and relevant discussions on the data acquisition and analysis. The findings are summarized together with a discussion of the results. The conclusions drawn from these results are included. The bulk of the data acquired and the results computed from it are presented.

436 **(LBL—15594) Exploration and development of the Cerro Prieto geothermal field.** Lippmann, M.J.; Goldstein, N.E.; Halfman, S.E.; Witherspoon, P.A. (Lawrence Berkeley Lab., CA (USA); Comision Federal de Electricidad, Mexico City). Jul 1983. Contract AC03-76SF00098. 19p. (CONF-8310121—5; CERRO-PRIETO—31). NTIS, PC A02/MF A01. Order Number DE84002571.

From SPE annual technical conference; San Francisco, CA, USA (5 Oct 1983).

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A multidisciplinary effort to locate, delineate, and characterize the geothermal system at Cerro Prieto, Baja California, Mexico, began about 25 years ago. It led to the identification of an important high-temperature, liquid-dominated geothermal system which went into production in 1973. Initially, the effort was undertaken principally by the Mexican electric power agency, the Comision Federal de Electricidad (CFE). Starting in 1977 a group of US organizations sponsored by the US Department of Energy, joined CFE in this endeavor. An evaluation of the different studies carried out at Cerro Prieto has shown that: (1) surface electrical resistivity and seismic reflection surveys are useful in defining targets for exploratory drilling; (2) the mineralogical studies of cores and cuttings and the analysis of well logs are important in designing the completion of wells, identifying geological controls on fluid movement, determining thermal effects and inferring the thermal history of the field; (3) geochemical surveys help to define zones of recharge and paths of fluid migration; and (4) reservoir engineering studies are necessary in establishing the characteristics of the reservoir and in predicting its response to fluid production.

437 **(PB—83-242164) Execution of deep dipole geoelectrical soundings in areas of geothermal interest. Final report.** Patella, D. (Commission of the European Communities, Luxembourg). [nd]. 117p. (EUR—8048-EN). NTIS, PC E06/MF E06.

It is suggested that deep geoelectrical problems may be resolved by carrying out dipole soundings in the field and applying a quantitative interpretation in the Schlumberger domain. The 'transformation' of original field dipole sounding curves into equivalent Schlumberger curves is outlined for the cases of layered structures and arbitrary underground structures. Theoretical apparent resistivity curves are derived for soundings over bidimensional structures. Following a summary of the geological features of the Travale-Radicondoli geothermal area of Italy, the dipole sounding method employed for this field study and the means of collecting and analyzing the data, are outlined.

1504 Legal And Institutional Aspects

438 **(CONF-831041—13) Towards solving the conflict between geothermal resource uses.** Intemann, P.R. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE84001991.

From 1983 Geothermal Resources Council's annual meeting; Portland, OR, USA (24 Oct 1983).

The development of a geothermal resource for energy is often seriously hindered by conflict with the alternative use of the same geothermal resource for recreation. Incompatibility between the development of geothermal energy and the enjoyment of surficial thermal features has constrained development in Japan, New Zealand, Europe, and the United States. Four approaches to the resolution of this problem have been identified. They are (1) research, (2) new technology, (3) design, and (4) marketing.

439 **(P—700-83-004) Public service impacts of geothermal development: cumulative impacts study of the Geysers KGRA. Final staff report.** Matthews, K.M. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jul 1983. 256p. NTIS, PC A12/MF A01. Order Number DE84900192.

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The number of workers currently involved in the various aspects of geothermal development in the Geysers are identified. Using two different development scenarios, projections are made for the number of power plants needed to reach the electrical generation capacity of the steam resource in the Geysers. The report also projects the cumulative number of workers needed to develop the steam field and to construct, operate, and maintain these power plants. Although the number of construction workers fluctuates, most are not likely to become new, permanent residents of the KGRA counties. The administrative and public service costs of geothermal development to local jurisdications are examined, and these costs are compared to geothermal revenues accruing to the local governments. Revenues do not cover the immediate fiscal needs resulting from increases in local road maintenance and school enrollment attributable to geothermal development. Several mitigation options are discussed and a framework presented for calculating mitigation costs for school and road impacts.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 447, 1379

440 **(CONF-831041—16) Evaluation of NEPA-based environmental commitments at four geopressured geothermal design wells.** Reed, A.W.; Hunsaker, D.B. Jr.; Roop, R.D.; Webb, J.W. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001974.

From 1983 Geothermal Resources Council's annual meeting; Portland, OR, USA (24 Oct 1983).

This study verifies the implementation and effectiveness of environmental mitigation and monitoring commitments made by the US Department of Energy in National Environmental Policy Act documents [Environmental Assessments (EAs)] prepared for four geopressure design well projects, one in Texas and three in Louisiana. The evaluation was based on visits to the project sites conducted by Oak Ridge National Laboratory staff in August 1982 and April 1983, and on a review of monitoring and project activity reports provided by DOE subcontractors. Subcontractors responsible for drilling and testing activities at the well sites adequately implemented most of the mitigation measures described in each project's EA. Exceptions included the lack of impermeable liners for drilling mud pits at three sites and the lack of a ring levee at one site. Water quality, noise, and air monitoring were not performed as strictly as outlined in the EAs. A review of the data collected to date indicates that no significant environmental degradation has occurred. Additional or future monitoring needs, especially with regard to subsidence, microseismicity, and groundwater and soil sampling were recommended.

441 **(DOE/SF/11664—T1) Direct Chlorination Process for geothermal power plant off-gas - hydrogen sulfide abatement.** Sims, A.V. (Sheinbaum (I.) Co., Inc., Monrovia, CA (USA)). Jun 1983. Contract AC03-82SF11664. 58p. NTIS, PC A04/MF A01. Order Number DE84001102.

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The Direct Chlorination Process removes hydrogen sulfide from geothermal off-gases by reacting hydrogen sulfide with chlorine in the gas phase. Hydrogen chloride and elemental sulfur are formed by this reaction. The Direct Chlorination Process has been successfully demonstrated by an on-site operation of a pilot plant at the 3 M We HPG-A geothermal power plant in the Puna District on the island of Hawaii. Over 99.5% hydrogen sulfide removal was achieved in a single reaction stage. Chlorine gas did not escape the pilot plant, even when 90% excess chlorine gas was used. A preliminary economic evaluation of the Direct Chlorination Process indicates that it is very competitive with the Stretford Process Compared to the Stretford Process, the Direct Chlorination process requires about one-third the initial capital investment and about one-fourth the net daily expenditure. Because of the higher cost of chemicals and the restricted markets in Hawaii, the economic viability of this process in Hawaii is questionable.

442 **(LA—9854-PR) Water quality in the vicinity of Fenton Hill. Progress report 1981 and 1982.** Purtymun, W.D.; Ferenbaugh, R.W.; Becker, N.M.; Adams, W.H.; Maes, M.N. (Los Alamos National Lab., NM (USA)). Sep 1983. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01. Order Number DE84002317.

As part of a continuing program of environmental studies, water quality data have been collected from established surface and ground water stations and from ponds and pond discharges at Fenton Hill Site located in the Jemez Mountains. Most of these stations were established in 1973, and water quality data have been collected since that time. There have been slight variations in the chemical quality of water from the surface and ground water locations; however, these variations are within normal seasonal fluctuations. The discharge from ponds at Fenton Hill infiltrates into canyon alluvium within 400 m of the site. Monitoring surface and spring discharge downgradient from the ponds failed to detect any effects resulting from water released from the ponds. Total dissolved solids and calcium have increased in water from well FH-1, which furnishes the water supply for the site. This increase is caused by the decreasing water level in the well resulting in yield from beds with a slightly different quality than has been found in previous years.

443 **(LBL—16218) Geothermal injection monitoring with dc resistivity methods.** Wilt, M.J.; Pruess, K.; Bodvarsson, G.S.; Goldstein, N.E. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 8p. (CONF-831041—15). NTIS, PC A02/MF A01. Order Number DE84001817.

From 1983 Geothermal Resources Council's annual meeting; Portland, OR, USA (24 Oct 1983).

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Injection into an idealized geothermal reservoir is considered, assuming that the injected water differs in temperature and salinity from in-place fluids. Changes in formation resistivity resulting from temperature and salinity variations are evaluated, and numerical simulation methods are used to predict effects which would be observed by means of dc resistivity monitoring. The resistivity calculations were performed using a three-dimensional computer code to simulate results from two different resistivity arrays, a dipole-dipole array and a downhole-surface array. Calculations show that the dipole-dipole method is relatively insensitive to changes due to injection , but downhole-surface measurements are very sensitive. From the simulated downhole-surface measurements a bell-shaped curve for resistivity change is obtained, from which the position of the chemical front may be approximately determined. Resistivity changes from temperature variations are rather small and probably cannot be detected in field measurements. Resistivity measurements are more than twice as sensitive when injected water is more saline than the in-situ reservoir fluid. This suggests that it may be easier to monitor the location of injected water if geothermal brine is reinjected rather than fresher water.

444 **(ORNL/TM—8657) Evaluation of NEPA-based environmental commitments at four geopressure design wells.** Reed, A.W.; Hunsaker, D.B. Jr.; Roop, R.D.; Webb, J.W. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 68p. NTIS, PC A04/MF A01. Order Number DE84002380.

The implementation of environmental mitigation and monitoring commitments made for four geopressure design well projects was evaluated. The evaluation was based on site visits conducted in August 1982 and April 1983 and on a review of monitoring and project activity reports provided by DOE contractors. The projects evaluated include: Pleasant Bayou No. 1 in Brazoria County, Texas; Dow Parcperdue in Vermilion Parish, Louisiana; and Gladys McCall and Sweet Lake No. 1 well sites in Cameron Parish, Louisiana. The contractors responsible for drilling and testing activities at the well sites have adequately implemented most of the mitigation measures described in each project's site-specific Environmental Assessment (EA). Exceptions include the lack of impermeable liners for drilling mud pits at the Dow Parcperdue, Gladys McCall, and Pleasant Bayou sites and the lack of a ring levee at the Pleasant Bayou site. Air and water quality and noise monitoring activities were not performed as strictly as outlined in the EAs. A review of the monitoring data collected to date indicates that no significant environmental degradation has occurred. This report recommends additional or future monitoring needs, especially with regard to soil contamination, subsidence, and microseismicity, and provides guidance for decommissioning.

445 **(USGS-OFR—78-597) Monitoring crustal deformation in The Geysers-Clear Lake geothermal area, California.** Lofgren, B.E. (Geological Survey, Sacramento, CA (USA)). 1978. 44p. NTIS, PC A03/MF A01. Order Number DE84900013.

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Geodetic surveys since 1972-1973 reveal significant crustal deformation in The Geysers-Clear Lake region. Resurveys of precise control networks are measuring both vertical and horizontal ground movement, with most of the change continuing in the area of geothermal fluid withdrawal. Preliminary evidence suggests right-lateral horizontal movement on northwest-trending fault systems and vertical and horizontal compression of the deep geothermal reservoir system. A direct correlaton is suggested between ground-surface deformation and subsurface pressure changes in the reservoir system. Although surface changes appear too small to be of environmental concern in The Geysers-Clear Lake region, they indicate hydrodynamic changes in the reservoir of significant import.

1508 Geothermal Power Plants

446 **(EGG-GTH—6376) Effects of vaporizer and evaporative-condenser size on geofluid effectiveness and cost of electricity for geothermal binary power plants.** Demuth, O.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1983. Contract AC07-76ID01570. 44p. NTIS, PC A03/MF A01. Order Number DE84002386.

A special study was conducted to investigate the influences of minimum approach temperature differences occurring in supercritical-heater/vaporizer and evaporative-condenser heat rejection systems on geothermal-electric binary power plant performance and cost of electricity. For the systems investigated optimum pinch points for minimizing cost of electricity were estimated to range from 5 to 7°F for the heater vaporizer. The minimum approach of condensing temperature to wet-bulb temperature for evaporative condensers was estimated to be about 30°F in order to achieve the lowest cost of electricity.

1509 Geothermal Engineering

447 **(EER/TR—11-83) Geoscience-related research needs for geothermal energy technology. Final report.** Crane, C.H.; Markiewicz, J.J. Jr. (Engineering and Economics Research, Inc., Vienna, VA (USA)). 30 Sep 1983. Contract AC01-82ER30041. 85p. NTIS, PC A05/MF A01. Order Number DE84001837.

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A project to identify and prioritize geoscience-related research needs that would be of significant benefit in the assessment, exploration, and development of US geothermal energy resources is described. The federal research needs as identified by the Panel are summarized. The research needs are organized into specific research needs for four technology areas and a group of generic research needs which relate to all of the technology areas. Arranged in order of overall need for research, these technology areas are: reservoir engineering; resource exploration and reservoir definition; well drilling, completion, and stimulation; and environmental monitoring and control. The generic research needs are: geoscience case studies, scientific drilling, information and technology transfer, and improved research coordination. (MHR)

448 **(LA—9857-HDR) Acord 1-26 hot, dry well, Roosevelt Hot Springs hot dry rock prospect, Utah.** Shannon, S.S. Jr.; Pettitt, R.; Rowley, J.; Goff, F.; Mathews, M.; Jacobson, J.J. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01. Order Number DE84002293.

The Acord 1-26 well is a hot, dry well peripheral to the Roosevelt Hot Springs known geothermal resource area (KGRA) in southwestern Utah. The bottom-hole temperature in this 3854-m-deep well is 230°C, and the thermal gradient is 54°C/km. The basal 685 m, comprised of biotite monzonite and quartz schist and gneiss, is a likely hot, dry rock (HDR) prospect. The hole was drilled in a structural low within the Milford Valley graben and is separated from the Roosevelt KGRA to the east by the Opal Mound Fault and other basin faults. An interpretation of seismic data approximates the subsurface structure around the well using the lithology in the Acord 1-26 well. The hole was drilled with a minimum of difficulty, and casing was set to 2411 m. From drilling and geophysical logs, it is deduced that the subsurface blocks of crystalline rock in the vicinity of the Acord 1-26 well are tight, dry, shallow, impermeable, and very hot. A hydraulic fracture test of the crystalline rocks below 3170 m is recommended. Various downhole tools and techniques could be tested in promising HDR regimes within the Acord 1-26 well.

449 **(LBL—16207) Summary of well-testing activities at Lawrence Berkeley Laboratory, 1975-1983.** Bodvarsson, M.G.; Benson, S.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 10p. (CONF-831041—12). NTIS, PC A02/MF A01. Order Number DE84001099.

From 1983 Geothermal Resources Council's annual meeting; Portland, OR, USA (24 Oct 1983).

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Well test data collected from various geothermal fields by the geothermal group at Lawrence Berkeley Laboratory are presented. The type of well tests conducted, the instrumentation used and the data collected are described. Experience gained through interpretation of the data has helped identify problems in test procedures and interpretative methods.

450 **(LBL—16329) Fluid and heat flow in gas-rich geothermal reservoirs.** O'Sullivan, M.J.; Bodvarsson, G.S.; Pruess, K.; Blakeley, M.R. (Lawrence Berkeley Lab., CA (USA)). Jul 1983. Contract AC03-76SF00098. 35p. (CONF-8310121—4). NTIS, PC A03/MF A01. Order Number DE84001096.

From SPE annual technical conference; San Francisco, CA, USA (5 Oct 1983).

Numerical-simulation techniques are used to study the effects of noncondensible gases (CO_2) on geothermal reservoir behavior in the natural state and during exploitation. It is shown that the presence of CO_2 has large effects on the thermodynamic conditions of a reservoir in the natural state, especially on temperature distributions and phase compositions. The gas will expand two-phase zones and increase gas saturations to enable flow of CO_2 through the system. During exploitation, the early pressure drop is primarily due to degassing of the system. This process can cause a very rapid initial pressure drop, on the order of tens of bars, depending upon the initial partial pressure of CO_2. The following gas content from wells can provide information on in-place gas saturations and relative

permeability curves that apply at a given geothermal resource. Site-specific studies are made for the gas-rich two-phase reservoir at the Ohaki geothermal field in New Zealand. A simple lumped-parameter model and a vertical column model are applied to the field data. The results obtained agree well with the natural thermodynamic state of the Ohaki field (pressure and temperature profiles) and a partial pressure of 15 to 25 bars is calculated in the primary reservoirs. The models also agree reasonably well with field data obtained during exploitation of the field. The treatment of thermophysical properties of H_2O-CO_2 mixtures for different phase compositions is summarized.

451 **(SAND—82-2690) Geothermal technology development program. Annual progress report, October 1981-September 1982.** Kelsey, J.R. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1983. Contract AC04-76DP00789. 257p. NTIS, PC A12/MF A01. Order Number DE84001915.

The status of ongoing Research and Development (R & D) within the Geothermal Technology Development Program is described. The program emphasizes research in rock penetration mechanics, fluid technology, borehole mechanics, diagnostics technology, and permeability enhancement.

452 **(SAND—83-1095C) Geothermal drilling and completion research and development program.** Kelsey, J.R.; Allen, A.D. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 17p. (CONF-8310177—3). NTIS, PC A02/MF A01. Order Number DE84001647.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

Current activities include development of high temperature drilling fluids, methods for plugging lost circulation zones, advanced rock cutting techniques, and borehole instrumentation. Three specific projects which are being pursued include: a method for locating fractures which do not intersect the wellbore, a laboratory for simulating lost circulation zones - to be used for development of new materials and techniques, and the understanding of the capabilities and limitations of polycrystalline diamond cutter bits in the geothermal environment.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 740

453 **(DOE/ID/12193—3) Commercial production of ethanol in the San Luis Valley, Colorado. Final report.** Hewlett, E.M.; Erickson, M.V.; Ferguson, C.D.; Boswell, B.S.; Walter, K.M.; Hart, M.L.; Sherwood, P.B. (WESTEC Services, Inc., San Diego, CA (USA)). Jul 1983. Contract FC07-81ID12193. 211p. NTIS, PC A10/MF A01. Order Number DE84002425.

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The commercial feasibility of producing between 76 and 189 million liters (20 to 50 million gallons) of ethanol annually in the San Luis Valley, Colorado using geothermal energy as the primary heat source was assessed. The San Luis Valley is located in south-central Colorado. The valley is a high basin situated approximately 2316 meters (7600 feet) above sea level which contains numerous warm water wells and springs. A known geothermal resource area (IGRA) is located in the east-central area of the valley. The main industry in the valley is agriculture, while the main industry in the surrounding mountains is lumber. Both of these industries can provide feedstocks for the production of ethanol.

454 **(DOE/R4/10483—T1) Feasibility of using hydrothermal resources in Malaysian prawn aquaculture. Final report.** Smith, T.I.J.; Rhodes, R.J.; Wannamaker, A.W. (South Carolina Wildlife and Marine Resources Dept., Charleston (USA). Marine Resources Div.). Aug 1982. Contract FG44-81R410483. 44p. NTIS, PC A03/MF A01. Order Number DE84000390.

The potential application of geothermal resources in South Carolina for freshwater prawn aquaculture was examined. In coastal S.C. 23 existing geothermal well sites were identified which encompassed an area which ranged from Georgetown to Beaufort. Depth averaged ~ 615 m while temperature averaged ~ 37°C. Artesian flow rates varied from 190 to 2650 l/min. Detailed water quality analyses were conducted at 12 sites. In general, major differences from surface waters were in chlorides, fluorides, dissolved solids, ph, alkalinity, and ammonia levels. A detailed replicated laboratory study was conducted to examine the effect of geothermal water on growth and survival of prawns. After 42 days very poor survival was recorded from the various 100% geothermal water treatments. However, 50:50 mixture of shallow well water and geothermal water resulted in a survival rate of 83%, which was similar to the control treatments. Growth was also similar to that observed among the control animals.

455 **(P—500-82-055) Bridgeport Geothermal Energy Project: a heating district and small-scale-electric feasibility investigation. Final report.** (Lahontan, Inc., Sacramento, CA (USA)). Sep 1982. 61p. NTIS, PC A04/MF A01. Order Number DE84900260.

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The Bridgeport Geothermal Project, a proposed community heating district, appears to be feasible. Analysis of the feasibility of the Bridgeport Geothermal Project required three critical assumptions: a successful supply well, a commercially viable wellhead generator, and successfully obtaining simultaneous financing from private investors, a commercial lendor and a granting agency. The geothermal supply well for the Bridgeport Project will be sited near Travertine Hot Springs about 1 1/2 miles southeast of town. The well should yield 1000 gallons per minute at 205°F to 240°F. The hot brine will be piped (1) to a primary heat exchanger for the heating district which will distribute heat to public and commercial buildings via a fresh water loop, and (2) to an organic Rankine boiler to drive a 500 kW (gross) generator. The institutional structure for the project is well established. The capital cost of the installed project will be about $4.1 million to be raised through equity, commercial debt and grant funding. The system revenues are projected to result in a positive cash flow in the eighth year of operation, and over a 20 year payout are projected to yield an internal rate of return (IRR) of 23^+ % to the private investors.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 1392

456 **(CONF-831041—14) Values for conductive heat transfer in geothermal technologies.** Intemann, P.R.; Sharp, R.D. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE84001990.

From 1983 Geothermal Resources Council's annual meeting; Portland, OR, USA (24 Oct 1983).

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Thermal conductivity and diffusivity of the subsurface are evaluated as critical parameters in the application of certain geothermal technologies. The variability of these parameters as a function of other subsurface properties is investigated. A simple method of estimating thermal conductivity and diffusivity from available information at specific locations is explained, and an interactive computer program that has been developed to assist in this task is described.

16 TIDAL POWER

1607 Tidal Power Plants

457 **(DOE/R4/10218—T1) Low-head tidal power in South Carolina. Feasibility study.** (Cubit Engineering Ltd., Clemson, SC (USA)). Dec 1981. Contract FG44-80R410218. 24p. NTIS, PC A02/MF A01. Order Number DE84000385.

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This report details the possibilities of extracting tidal power from sites with moderate tides and naturally occurring storage locations (estuaries). The important points covered include: available

power, power extraction, and the best locations and techniques to utilize the tides in South Carolina.

17 WIND ENERGY

1701 Availability (climatology)

458 **(SERI/STR—214-1708) County-level wind resource estimates for DOE Region V. Final report.** Groveman, B.S.; Easterly, J.L. (PRC Systems Services Co., McLean, VA (USA)). Sep 1983. Contract AC02-77CH00178. 62p. NTIS, PC A04/MF A01. Order Number DE84000009.

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The objectives of the study were to develop an annual mean wind speed forecasting model for site-specific applications in the Great Lakes region; develop an annual mean power law exponent model for the region; utilize the models to characterize county-level wind resources for residential, agricultural, commercial, and industrial market sectors; and identify normalized values for average diurnal and monthly wind speeds. The analysis was based on the evaluation of wind speed and topographical data for 124 sites in and around the Great Lakes region. With the use of regression analysis techniques, wind speed to various independent variables such as Pacific Northwest Laboratories' forecast for the area; average angular horizon; site elevation; and percentage of land covered by forests. The wind speed forecast equations and topographic maps for Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin were used to characterize the wind resource for each of the 524 counties in Region V. Of the 524 counties, 241 had some areas with wind resources greater than 5 m/s, and only 24 counties had some areas where the average mean wind speed exceeded 6 m/s. At the state level, Minnesota has the highest average wind speeds in the region, while Indiana has the lowest.

1706 Wind Energy Engineering

459 **(ATR—80(7702)-1) Darrieus wind-turbine performance and weight-scaling calculations. Final report.** Lapin, E.E. (Aerospace Corp., Los Angeles, CA (USA). Energy and Resources Div.). Apr 1980. Contract AC01-76ET20029. 227p. NTIS, PC A11/MF A01. Order Number DE84001006.

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The distribution of weight by component in three existing vertical axis wind turbines is briefly tabulated. An approach is given for studying Darrieus machine element weights, accounting for the several possible operating regimes and the maximum forces generated in these regimes which produce loads imposed on the blades and the reactions on the interfacing elements. The approach taken is to develop a means for analysis of the dominating load creating member, the blades, and a means for analysis of aerodynamic performance under a typical distribution of wind velocity. Then the blade structural loading is determined for appropriate designs for the conditions of use including the blades at rest in maximum winds. Computational results of the investigation are graphed. (LEW)

460 **(CONF-831093—2) Recent advances in variable speed electrical generator systems for large wind turbines.** Andersen, T.S.; Hughes, P.S.; Klein, F.F.; Mutone, G.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1983. Contract AC02-81RA50292. 8p. NTIS, PC A02/MF A01. Order Number DE84001833.

From Wind expo '83 and AWEA national conference; San Francisco, CA, USA (16 Oct 1983).

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Major variable speed electrical generator system design objectives have been verified through large-scale experiment. Full exploitation of variable speed generator benefits can revolutionize large wind turbine design. The greatest advantages come not only from the improved aerodynamic efficiency of keeping tip speed proportional to wind speed, but from dramatic reduction in drive train resonances, elimination of dissipative damping losses, easy motorized turbine start, and isolation of turbine dynamics from the electrical network. Experimental verification proceeded by two steps: first, actual control hardware and software were verified with a hybrid simulation of a full wind turbine system; then the controls were combined with power thyristor bridges configured as a cycloconverter and motor-generator test train to implement a variable speed generator and a simulated wind-turbine/drive train. Although the existing equipment presented several constraints on testing latitude, major features demonstrated include: (1) variable frequency motoring to 50% speed for quick, efficient turbine start-up; (2) synchronization below, at, and above synchronous speeds, both steady state and transient; (3) net power output up to 120 kW with stable response to 50 kW step changes in demand within one second and similarly responsive control of VARs; (4) steady power and VAR output throughout speed transients from ten percent below to ten percent above synchronous speed; (5) output voltage waveform with less than five percent total harmonic distortion; and (6) damping of simulated drive train resonance at 0.2 Hz.

461 **(DOE/BP—182) Wake studies at the Goodnoe Hills MOD-2 site.** Baker, R.W.; Walker, S.N. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Oct 1982. 91p. (BPA—82-11). NTIS, PC A05/MF A01. Order Number DE84001883.

Wake measurements were performed using kite anemometers at the Goodnoe Hills MOD-2 site. The objectives of the work were to take measurements to define the wake and to verify the numerical wake model that treats wake similarly to jet-like flow. It is found that essentially two principal parameters govern wind turbine wakes - the thrust force that the turbine exerts on the flow, which determines the initial velocity or momentum deficit, and the ambient (free stream) and mechanical (wake) turbulence which control wake expansion and therefore wake velocity deficit decay. The basic wake theory equations for application to a wind turbine are developed and discussed, and measurement data and associated error are calculated and compared to the model. (LEW)

462 **(DOE/NASA/0007—1) How to protect a wind turbine from lightning.** Dodd, C.W.; McCalla, T. Jr.; Smith, J.G. (Southern Illinois Univ., Carbondale (USA). Coll. of Engineering and Technology). Sep 1983. Contract AI01-76ET20320. 109p. (NASA-CR—168229). NTIS, PC A06/MF A01. Order Number DE84001698.

This book discusses techniques for reducing the chances of lightning damage to wind turbines. The methods of providing a ground for a lightning strike are discussed. Then details are given on ways to protect electronic systems, generating and power equipment, blades, and mechanical components from direct and nearby lightning strikes.

463 **(DOE/NASA/3303—2) Stability analysis of flexible wind-turbine blades using finite-element method.** Kamoulakos, A. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Aug 1982. Contract AI01-76ET20320. 156p. (NASA-CR—168107). NTIS, PC A08/MF A01. Order Number DE84002747.

Thesis.

Static vibration and flutter analysis of a straight elastic axis blade was performed based on a finite element method solution. The total potential energy functional was formulated according to linear beam theory. The inertia and aerodynamic loads were formulated according to the blade absolute acceleration and absolute velocity vectors. In vibration analysis, the direction of motion of the blade during the first out-of-lane and first in-plane modes was examined; numerical results involve NASA/DOE Mod-0, McCauley propeller, north wind turbine and flat plate behavior. In flutter analysis, comparison cases were examined involving several references. Vibration analysis of a nonstraight elastic axis blade based on a finite element method solution was performed in a similar manner with the straight elastic axis blade, since it was recognized that a curved blade can be approximated by an assembly of a sufficient number of straight blade elements at different inclinations with respect to a common system of axes. Numerical results involve comparison between the behavior of a straight and a curved cantilever beam during the lowest two in-plane and out-of-plane modes.

464 **(DOE/NASA/3303—3) Simplified aeroelastic modeling of horizontal-axis wind turbines.** Wendell, J.H. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1982. Contract AI01-76ET20320. 229p. (NASA-CR—168109). NTIS, PC A11/MF A01. Order Number DE84002746.

Portions are illegible in microfiche products; Thesis.

This report examines certain aspects of the aeroelastic modeling and behavior of the horizontal axis wind turbine (HAWT). Two simple three degree of freedom models are described in this report, and tools are developed which allow other simple models to be derived. The first simple model developed is an equivalent hinge model to study the flap-lag-torsion aeroelastic stability of an isolated rotor blade. The model includes nonlinear effects, preconing, and noncoincident elastic axis, center of gravity, and aerodynamic center. A stability study is presented which examines the influence of key parameters on aeroelastic stability. Next, two general tools are developed to study the aeroelastic stability and response of a teetering rotor coupled to a flexible tower. The first of these tools is an aeroelastic model of a two-bladed rotor on a general flexible support. The second general tool is a harmonic balance solution method for the resulting second order system with periodic coefficients. The second simple model developed is a rotor-tower model which serves to demonstrate the general tools. This model includes nacelle yawing, nacelle pitching, and rotor teetering. Transient response time histories are calculated and compared to a similar model in the literature. Agreement between the two is very good, especially considering how few harmonics are used. Finally, a stability study is presented which examines the effects of support stiffness and damping, inflow angle, and preconing.

465 **(DOE/NASA/20320—51) Performance comparison between NACA 23024 and NACA 64_3-618 airfoil-configuration rotors for horizontal-axis wind turbines.** Corrigan, R.D.; Ensworth, C.B.F.; Keith, T.G. Jr. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Toledo Univ., OH (USA)). 1983. Contract AI01-76ET20320. 19p. (NASA-TM—83471; CONF-830631—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84002100.

From 6. biennial wind energy conference; Minneapolis, MN, USA (1 Jun 1983).

Wind turbine performance tests were conducted on the Mod-O 100-kW horizontal-axis wind turbine to compare a tip-controlled rotor having NACA 23024 airfoil tip sections with a similar rotor having NACA 64_3-618 airfoil tip sections. The inboard portion of the blades had an NACA 23024 airfoil section. The wind turbine configuration consisted of the nacelle-rotor assembly mounted atop a tubular tower with the rotor axis 38 m above ground level. The rotor was 39 m in diameter, coned, and teetered and had 20° of pitch and flap coupling δ_3. The blades had 23 percent root cutout and the movable tip-control section covered the outer 31 percent of the blade. Testing was conducted at nominal rotor speeds of 20 and 31 rpm with the rotor downwind of the tower. The tests indicate improved performance for the rotor with the NACA 64_3-618 airfoil tip sections over the rotor with the NACA 23024 airfoil tip sections. In addition, performance was predicted for each rotor configuration by using two performanc prediction codes. This report presents the test results and compares them with each other and with predicted performance for both rotor configurations.

466 **(DOE/NASA/20320—52) Federal wind program at NASA Lewis Research Center.** Baldwin, D.H.; Linscott, B.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1983. Contract AI01-76ET20320. 21p. (NASA-TM—83480; CONF-830631—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84001909.

From 6. biennial wind energy conference; Minneapolis, MN, USA (1 Jun 1983).

The large wind turbine program is a major segment of the Federal Wind Program sponsored by the Department of Energy (DOE). The NASA Lewis Research Center manages the large horizontal axis wind turbine program for DOE. This program is directed toward development of the technology for safe, reliable, environmentally acceptable large wind turbines that have the potential to generate a significant amount of electricity at costs competitive with conventional electric generation systems. In addition, these large wind turbines must be fully compatible with electric utility operations and interface requirements. There are several ongoing lare wind system development projects directed toward meeting the technology requirements for utility applications. The first generation technology machines, Mod-OA and Mod-1, have successfully completed their planned periods of experimental operation. Disposition of these machines is nearly complete. The second generation machines, Mod-2's, continue experimental operation at Goodnoe Hills, WA, and Medicine Bow, WY. Design and engineering development of third generation, Mod-5, machines is underway. Initial experiment operation of Mod-5 is planned for DOE in late 1984 or early 1985. This report provides an overview of these project activities managed by NASA Lewis. In addition to these projects, NASA also is conducting research on large horizontal axis wind turbines. The four main areas of experimental research are: (1) aerodynamics; (2) structural dynamics and aeroelasticity; (3) composite and hybrid composite materials; and (4) multiple system interaction. Key research activities and results are described in this paper. Finally, the continuing need for future wind turbine research and technology development is explored.

467 **(DOE/NASA/20320—53) Examination, evaluation, and repair of laminated wood blades after service on the Mod-OA wind turbine.** Faddoul, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1983. Contract AI01-76ET20320. 43p. (NASA-TM—83483; CONF-831093—1). NTIS, PC A03/MF A01. Order Number DE84001931.

From Wind expo '83 and AWEA national conference; San Francisco, CA, USA (16 Oct 1983).

As a result of about 7 years of effort at the NASA Lewis Research Center, laminated wood blades were designed, fabricated, and installed on a 200-kW wind turbine (Mod-OA). The machine uses a two-blade rotor with a diameter of 38.1 m (125 ft). Each blade weighs less than 1361 kg (3000 lb). After operating in the field, two blade sets were returned for inspection. One set had been in Hawaii for 17 months (7844 h of operation) and the other had been at Block Island, Rhode Island, for 26 months (22 months operating - 7564 h). The Hawaii set was returned because one of the studs that holds the blade to the hub had failed. This was found to be caused by a combination of improper installation and inadequate corrosion protection. No other problems were found. The broken stud (along with four others that were badly corroded) was replaced and the blades are now in storage. The Block Island set of blades was returned at the completion of the test program, but one blade was found to have developed a crack in the leading edge along the entire span. This crack was found to be the result of a manufacturing process problem but was not structurally critical. When a load-deflection test was conducted on the cracked blade, the response was identical to that measured before installation. In general, the laminate quality of both blade sets was excellent. No significant internal delamination or structural defects were found in any blade. The stud bonding process requires close tolerance control and adequate corrosion protection, but studs can be removed and replaced without major problems. Moisture content stabilization does not appear to be a problem, and laminated wood blades are satisfactory for long-term operation on Mod-OA wind turbines.

468 **(DOE/R4/10249—T1) Improved generator for use with low-speed rotating machines. Final report.** Goerz, J.W. (Goerz (Jerry W.), Lexington, KY (USA)). 31 Mar 1983. Contract FG44-80R410249. 17p. NTIS, PC A02/MF A01. Order Number DE84000375.

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The goal of this project was to construct a low-technology, maintenance-free dc electrical generator suited for use with low-speed rotating machines such as windmills or waterwheels. The generator consists of permanent magnets affixed to the circumference of the rotating device, and stationary coils mounted on a semicircular frame. As the device rotates, the magnets move past the coils and magnetically induce an ac voltage in the coils. This voltage is rectified and stored in a battery. No gears, belts, or brushes are used, so the generator operates quietly and without maintenance. The purpose of mounting the magnets at the circumference

of the rotating device is to achieve high relative velocities between magnets and coils even at slow rotations, in the hope of extracting energy from very light winds or slowly flowing water. Such a generator was constructed as part of a ten-foot-diameter windmill to test the concept. The generator easily reaches charging voltages at low speeds, and operates quietly without mechanical wear. But the charging current is very low in comparison to a wind turbine of conventional design. The experiment allows fundamental design problems to be identified.

469 **(N—8323722) Proceedings: Small Wind Turbine Systems, 1981.** (Solar Energy Research Inst., Golden, CO (USA)). 1981. 438p. (SERI/CP—635-1212; CONF-8105117—). NTIS, PC A19/MF A01.

From Small wind turbine systems conference; Boulder, CO, USA (12 May 1981).

Small wind turbine technology is discussed. Systems development, test programs, utility interface issues, safety and reliability programs, applications, and marketing are discussed. For individual titles, see N83-23723 through N83-23741.

470 **(N—8323728) The 40 kW Giromill.** Anderson, J. (McDonnell Aircraft Co., St. Louis, MO (USA)). 1981. 13p. (CONF-8105117—). NTIS, PC A19/MF A01.

From Small wind turbine systems conference; Boulder, CO, USA (12 May 1981).

A prototype Giromill wind turbine is discussed. The Giromill is a vertical axis wind turbine with articulating vertical blades programmed through a microprocessor to catch the wind from any direction and maintain constant rotor RPM. The articulating blades provide not only a very high energy conversion efficiency but also a self-starting capability and additional safety by allowing the blades to weathervane in high winds. The blades are straight and simple structures with no twist and, much like the remaining structure, is less complex than many other windmills. Power transmission, control system, and electrical generator are located at the ground level for convenient access and maintenance. Direct mechanical power is also available at ground level for irrigation pumping.

471 **(SAND—82-2543) General method for fatigue analysis of vertical axis wind turbine blades.** Veers, P.S. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01. Order Number DE84002654.

The fatigue life of wind turbine blades that are exposed to the random loading environment of atmospheric winds is described with random data analysis procedures. The incident wind speed and the stresses caused by these winds are expressed in terms of probability density functions, while the fatigue life vs stress level relationship is treated deterministically. This approach uses a damage density function to express fatigue damage as a function of wind speed. By examining the constraints on the variables in the damage density expression, some generalizations of the wind turbine fatigue problem are obtained. The area under the damage density function is inversely related to total fatigue life. Therefore, an increase in fatigue life caused by restricted operation in certain wind regimes is readily visualized. An on parameter, which is the percentage of total time at each wind speed that the turbine actually operates, is introduced for this purpose. An example calculation is presented using data acquired from the DOE 100-kW turbine program.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 128, 502, 599

472 **(PB—83-239657) Emission characteristics of cooling towers using reclaimed wastewater in California. Potential for 'Salmonella' aerosol generation by cooling towers using treated wastewater. Final report Jul 79-Jan 81.** Fanelli, M.J.; Genigeorgis, C.; Chang, D.P.Y. (California Univ., Davis (USA)). 30 Jun 1981. 38p. NTIS, PC A03/MF A01.

The objective of this investigation was to determine if Salmonellae and Pseudomonads were present in cooling towers using recycled wastewater and whether numbers increase or decrease during cycling of the water through the tower. The limited number of samples collected limit conclusion on the commonness of the organism.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 104, 1358

473 **(PB—83-240671) Characterization of the NO/sub x/ and SO_2 control performances, Southern Indiana Gas and Electric Co., A.B. Brown Unit No. 1. Volume 1. program results. Final report May 81-Oct 82.** Peduto, E.F. Jr; Hall, R.R.; Tucker, G. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Jul 1983. 110p. (GCA-TR—82-23-G(1)). NTIS, PC A06/MF A01.

The five-volume report gives results of a continuous emissions monitoring program at Southern Indiana Gas and Electric Company's (SIGECO's) A.B. Brown Power Plant, to characterize the NOx and SO2 control performances of Unit 1 in terms of process variables. Volume I gives program results.

474 **(PB—83-240689) Characterization of the NO/sub x/ and SO_2 control performances, Southern Indiana Gas and Co., A.B. Brown Unit No. 1. Volume 2. program documentation. Final report May 81-Oct 82.** Peduto, E.F. Jr; Hall, R.R.; Tucker, G. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Jul 1983. 288p. (GCA-TR—82-23-G(2)). NTIS, PC A13/MF A01.

The five-volume report gives results of a continuous emissions monitoring program at Southern Indiana Gas and Electric Company's (SIGECO's) A.B. Brown Power Plant, to characterize the NOx and SO2 control performances of Unit 1 in terms of process variables. Volume II, discusses program documentation.

475 **(PB—83-240697) Characterization of the No/sub x/ and SO_2 control performances, southern Indiana Gas and Electric Co., A.B. Brown Unit No. 1. Volume 3. north module sulfur dioxide data reports. Final report May 81-Oct 82.** Peduto, E.F. Jr; Hall, R.R.; Tucker, G. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Jul 1983. 294p. NTIS, PC A13/MF A01.

The five-volume report gives results of a continuous emissions monitoring program at Southern Indiana Gas and Electric Company's (SIGECO's) A.B. Brown Power Plant, to characterize the NOx and SO2 control performances of Unit 1 in terms of process variables. Volume III discusses SO2 data reports for the north module.

476 **(PB—83-240705) Characterization of the No/sub s/ and SO_2 control performances, southern Indiana Gas and Electric Co., A.B. Brown Unit 1. Volume 4. south module sulfur dioxide data reports. Final report May 81-Oct 81-ot 82.** Peduto, E.F. Jr; Hall, R.R.; Tucker, G. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Jul 1983. 294p. NTIS, PC A13/MF A01.

The five-volume report gives results of a continuous emissions monitoring program at Southern Indiana Gas and Electric Company's (SIGECO's) A.B. Brown Power Plant, to characterize the NOx and SO2 control performances of Unit 1 in terms of process variables. Volume IV discusses SO2 data reports for the south module.

477 **(PB—83-240713) Characterizaiton of the No/sub x/ and SO_2 control performances, southern Indiana Gas and Electric Co., A.B. Brown Unit No. 1. Volume 5. oxides of nitrogen data reports. Final report May 81-Oct 82.** Peduto, E.F. Jr; Hall, R.R.; Tucker, G. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Jul 1983. 293p. NTIS, PC A13/MF A01.

The five-volume report gives results of a continuous emissions monitoring program at Southern Indiana Gas and Electric Company's (SIGECO's) A.B. Brown Power Plant, to characterize

the NOx and SO2 control performances of Unit 1 in terms of process variables. Volume V, discusses data reports for NOx.

478 **(PB—83-241364) Full-scale dual alkali fgd (flue gas desulfurization) demonstration at Louisville Gas and Electric Company. Final report Mar 79-May 81.** VanNess, R.P.; Woodland, L.R.; Gibson, E.D. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1983. 97p. NTIS, PC A05/MF A01.

The report summarizes the 1-year demonstration of the full-scale dual-alkali flue gas desulfurization (FGD) system at Louisville Gas and Electric Co.'s (LG/E's) Cane Run Unit 6. Systems performance is described in terms of performance guarantees and other parameters that were monitored throughout the demonstration. The report gives a detailed history of operation, including problems encountered in system operation and how they were solved. Capital and operating costs (estimated and incurred) are also reviewed.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 594

479 **(DOE/ET/29016—1) TVA's 500-kV electric and magnetic fields: measurements and analyses.** (Tennessee Valley Authority, Muscle Shoals, AL (USA)). Sep 1983. Contract AI05-79ET29016. 247p. NTIS MF A01. Order Number DE84000733.

Microfiche only, copy does not permit paper copy reproduction. Original copy available until stock is exhausted.

This report summarizes the results of the 500-kV electric and magnetic fields data project, performed by the Electrical Systems Group of the Tennessee Valley Authority (TVA). The objectives of the project were to measure, record, and analyze electric and magnetic fields in the vicintiy of TVA's 500-kV transmission lines. Also the effects of transmission line fields on the growth and development of selected agricultural and forest plant species were to be investigated. This report contains only the categorization and the statistical analysis of the fields data.

480 **(OA-tr—2591) Development of medium-voltage networks: general layout of electricity supply systems serving urban areas.** Thibon, D. Translated from *RGE, Revue Generale de l'Electricite ;* No. 7-8, 461-466(1982). 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83902910.

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The strategy for developing urban medium-voltage networks can only be based on trends of a general nature, because of the diversity of situations and layouts already in existence. The author defines these trends with regard to bulk-supply substations, the MV networks themselves, as well as the LV systems, specifying the main parameters which ought to influence decision-making.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 566

481 **(DOE/ER/75094—2) Proceedings of the 1983 American Nuclear Society Midwest regional conference.** (Illinois Univ., Urbana (USA)). 1983. Contract FG02-83ER75094. 88p. (CONF-8304130—Absts.). NTIS, PC A05/MF A01. Order Number DE84001391.

From ANS midwest regional student conference on meeting the nuclear challenge; Champaign, IL, USA (7 Apr 1983).

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Abstracts are presented for the following sessions: fusion power engineering; health physics; instrumentation and dosimetry; fusion physics and nuclear pumped lasers; numerical and computerized techniques; waste management; risk and safety analysis; materials and radiation effects; and thermal hydraulics - fission reactor engineering. (GHT)

482 **(SAND—83-1714C) Pit initiation resistance of ferritic stainless steels in chloride environments from 80° to 260°C.** Cieslak, W.R.; Duquette, D.J. (Sandia National Labs., Albuquerque, NM (USA); Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 1983. Contract AC04-76DP00789. 17p. (CONF-830845—5). NTIS, PC A02/MF A01. Order Number DE84000355.

From Environmental degradation of materials in nuclear power systems-water reactors; Myrtle Beach, SC, USA (22 Aug 1983).

The pitting resistance of high-purity ferritic stainless steels has been studied by potentiodynamic anodic polarization, mechanical film-rupture (scratch) testing, and microstructural examination. The purpose has been to determine the ability of the Fe-Cr-Mo alloys to resist pit initiation at temperatures up to 260°C in chloride environments. At temperatures exceeding about 200°C, Cr is shown to become much more effective than Mo to enhance alloy pitting resistance. In fact, at 260°C, 2% Mo does not noticeably affect the pitting resistance of 18% Cr or 28% Cr steels. Also, 5% Mo is more effective for the lower Cr than for the higher Cr alloy, unlike lower temperatures, at which the effect of the two elements is greater than additive. Preferential localized attack at microstructural features, e.g. inclusions, is not observed under any of the experimental conditions, rather the pit-initiation resistance is controlled solely by alloy composition.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 229, 497, 502, 518, 521, 523, 533, 536, 537, 538, 540, 541, 544, 546, 548, 549, 559, 562, 564, 565, 567, 569, 573, 579, 593

483 **(CONF-830845—6) Stress-corrosion cracking in BWR and PWR piping.** Weeks, R.W. (Argonne National Lab., IL (USA)). Jul 1983. Contract W-31-109-ENG-38. 32p. NTIS, PC A03/MF A01. Order Number DE84000613.

From Environmental degradation of materials in nuclear power systems-water reactors; Myrtle Beach, SC, USA (22 Aug 1983).

Intergranular stress-corrosion cracking of weld-sensitized wrought stainless steel piping has been an increasingly ubiquitous and expensive problem in boiling-water reactors over the last decade. In recent months, numerous cracks have been found, even in large-diameter lines. A number of potential remedies have been developed. These are directed at providing more resistant materials, reducing weld-induced stresses, or improving the water chemistry. The potential remedies are discussed, along with the capabilities of ultrasonic testing to find and size the cracks and related safety issues. The problem has been much less severe to date in pressurized-water reactors, reflecting the use of different materials and much lower coolant oxygen levels.

484 **(CONF-8310144—3) Mechanistic prediction of fission-product release under normal and accident conditions: key uncertainties that need better resolution.** Rest, J. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 61p. NTIS, PC A04/MF A01. Order Number DE84000591.

From Specialists' workshop on fission gas behavior in safety experiments; Cadarache, France (5 Oct 1983).

A theoretical model has been used for predicting the behavior of fission gas and volatile fission products (VFPs) in UO_2-base fuels during steady-state and transient conditions. This model represents an attempt to develop an efficient predictive capability for the full range of possible reactor operating conditions. Fission products released from the fuel are assumed to reach the fuel surface by successively diffusing (via atomic and gas-bubble mobility) from the grains to grain faces and then to the grain edges, where the fission products are released through a network of interconnected tunnels of fission-gas induced and fabricated porosity. The model provides for a multi-region calculation and uses only one size class to characterize a distribution of fission gas bubbles.

485 **(NUREG/CR—3048) Closeout of IE Bulletin 80-21: valve parts supplied by Malcom Foundry.** Foley, W.J.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Sep 1983. 30p. NTIS, PC A03/MF A01 - GPO $3.75. Order Number DE84900081.

Cracking of yokes in active valves in a safety-related system was discovered during pre-operational testing of the Residual Heat Removal System at Susquehanna 1. These defective yokes had been supplied to Anchor/Darling Valve Company by Malcolm Foundry Company, Inc. Because Malcolm Foundry had gone out of business, it was necessary to issue the Bulletin to utilities to determine directly whether Malcolm Foundry had provided parts to valve manufacturers other than Anchor/Darling. From results of the extensive survey of valve manufacturers generated by this Bulletin, it was determined that only Anchor/Darling had used Malcolm Foundry as a source of safety-related valve parts. On the basis of survey results and a search of Anchor/Darling records, it was found that only seven facilities had affected valves.

486 **(SAND—83-0658C) Aging of electronics with application to nuclear power plant instrumentation.** Johnson, R.T. Jr.; Thome, F.V.; Craft, C.M. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 14p. (CONF-831015—3). NTIS, PC A02/MF A01. Order Number DE84000465.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A survey to identify areas of needed research to understand aging mechanisms for electronics in nuclear power plant instrumentation has been completed. The emphasis was on electronic components such as semiconductors, capacitors, and resistors used in safety-related instrumentation in the reactor containment area. The environmental and operational stress factors which may produce degradation during long-term operation were identified. Some attention was also given to humidity effects as related to seals and encapsulants, and failures in printed circuit boards and bonds and solder joints. Results suggest that neutron as well as gamma irradiations should be considered in simulating the aging environment for electronic components. Radiation dose-rate effects in semiconductor devices and organic capacitors need to be further investigated, as well as radiation-voltage bias synergistic effects in semiconductor devices and leakage and permeation of moisture through seals in electronics packages.

487 **American National Standard: for subcompartment pressure and temperature transient analysis in light water reactors.** La Grange Park, IL; American Nuclear Society (1982). 35p. (ANSI/ANS—56.10-1982). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $30.00.

This standard provides criteria for the analysis of subcompartment pressure, temperature, and flooding transients resulting form high- or moderate-energy line breaks and other events both inside and outside light water reactor primary containments. Criteria are provided for the determination of mass and energy release rates and for the formulation of input parameters to assure a conservative subcompartment or building design basis. Attention is given to the intended use of the transient data. Interfaces with active and passive systems such as valves and structural heat sinks are treated. The qualification of equipment and design of their supports is also addressed through treatment of long-term pressure and temperature transients and also asymmetric pressure loading and its effects.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 229, 483, 484, 485, 486, 487, 497, 499, 502, 510, 518, 520, 523, 530, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 549, 550, 551, 552, 553, 554, 555, 556, 557, 562, 564, 565, 567, 568, 569, 572, 573, 574, 575, 576, 577, 579, 580, 593

488 **(EGG-M—26782) Pressurized-water-reactor low-order model with validation.** Tylee, J.L.; Venhuizen, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 26p. (CONF-830707—4). NTIS, PC A03/MF A01. Order Number DE84001051.

From Summer computer simulation conference; Vancouver, Canada (11 Jul 1983).

A sixth-order model of a pressurized-water reactor (PWR) is developed and evaluated. The model is obtained by using point reactor kinetics, a single fuel rod, and a single lumped reactor-coolant node. Model state variables include delayed-neutron-precursor concentrations, average fuel and cladding temperatures, average core-coolant temperature, and measured reactor-outlet temperature. The model is validated with data from a test-reactor facility (LOFT).

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 503, 504, 505, 775, 776, 835, 836

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 519

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 545, 565, 570, 571, 581, 582, 591

489 **(CONF-830607—27) Fatigue of LMFBR piping due to flow stratification.** Woodward, W.S. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Energy Systems Div.). 1983. Contract AC15-76CL50003. 11p. NTIS, PC A02/MF A01. Order Number DE84001851.

From American Society of Mechanical Engineers pressure vessel and piping conference; Portland, OR, USA (19 Jun 1983).

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Flow stratification due to reverse flow was simulated in a 1/5-scale water model of a LMFBR primary pipe loop. The stratified flow was observed to have a dynamic interface region which oscillated in a wave pattern. The behavior of the interface was characterized in terms of location, local temperature fluctuation and duration for various reverse flow conditions. A structural assessment was performed to determine the effects of stratified flow on the fatigue life of the pipe. Both the static and dynamic aspects of flow stratification were examined. The dynamic interface produces thermal striping on the inside of the pipe wall which is shown to have the most deleterious effect on the pipe wall and produce significant fatigue damage relative to a static interface.

490 **(CONF-831111—6) Model of a once-through steam generator with moving boundaries and a variable number of nodes.** Berry, G. (Argonne National Lab., IL (USA)). 1983. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01. Order Number DE83015692.

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

A model of a once-through steam generator (OTSG) with moving boundaries and variable nodes was developed for liquid-metal fast breeder reactor (LMFBR) applications. The main advantage of the current model is its ability to generate a variable number of nodes. The OTSG model consists of four regions identified as subcooled, nucleate-boiling, film-boiling, and superheated. The number of nodes within each region is variable, which allows the user to change the number of nodes and assess this effect on the resulting solution. The model also permits the elimination of regions (during a cool-down transient) or the formation of regions (start-up, or reheat after a cool-down transient). The model can also be used to simulate a boiler by eliminating the film-boiling and superheated regions. The model permits the user to select the appropriate heat-transfer correlations or use the default selections. The model has a separate section where steady-state values are determined before the code enters the transient section. The paper describes the formation of the model, and the steady-state and transient solution methods. Typical results are presented.

491 **(HEDL-SA—2757-FP) Fuel transient deformation.** Slagle, O.D.; Bard, F.E.; Gneiting, B.C.; Thielges, J.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1982. Contract AC06-76FF02170. 18p. (CONF-830805—63). NTIS, PC A02/MF A01. Order Number DE84001480.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

High-temperature deformation behavior of mixed-oxide fuel plays an important role in determining the amount of fuel loading against the cladding that occurs during a reactor power increase or transient. High-temperature creep behavior of mixed-oxide fuel has been experimentally determined in the temperature range from 2100 to 2600°C. The results indicate that at temperatures above 2300°C an additional component of creep is operative. High-temperture hot-pressing tests on mixed-oxide fuel have been performed at temperatures up to 2600°C under hydrostatic loading. At temperatures above 2400°C only 2% hot pressing densification was measured, which was considerably less than expected by extrapolating the low-temperature behavior. A fuel pin equivalent in size and fuel material to an FFTF fuel pin was transient tested in a TREAT MARK IIIA flowing sodium loop under conditions typical of a 1$/s overpower transient.

492 **(HEDL-SA—2857-FP) LMFBR intermediate-heat-exchanger experience.** Cho, S.M.; Beaver, T.R. (FW Energy Applications, Inc., Livingston, NJ (USA); Westinghouse Hanford Co., Richland, WA (USA)). 1983. Contract AC06-76FF02170. 24p. (CONF-830905—10). NTIS, PC A02/MF A01. Order Number DE84001495.

From Joint power generation conference; Indianapolis, IN, USA (25 Sep 1983).

This paper presents developmental and operating experience of large Intermediate Heat Exchangers (IHX's) in US from the Fast Flux Test Facility (FFTF) to the Clinch River Breeder Reactor Plant (CRBRP) to the Large Development Plant (LDP). Design commonalities and deviations among these IHX's are synopsized. Various developmental tests that were conducted in the areas of hydraulic, structural and mechanical design are also presented. The FFTF is currently operating. Performance data of the FFTF IHXs are reviewed, and comparisons between actual and predicted performances are made. The results are used to assess the adequacy of IHX designs.

493 **(HEDL-SA—2976) Characterization of higher-actinide irradiation-test pellets.** Wilson, C.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76FF02170. 31p. (CONF-8310175—1). NTIS, PC A03/MF A01. Order Number DE84001479.

From 36. annual Pacific Coast Regional meeting of the American Ceramic Society; San Diego, CA, USA (3 Oct 1983).

Hot pressed pellets of Cm_2O_3, Am_2O_3 and (Am, Cm, La, Ce, Nd, $Sm)_2O_3$, prepared for a joint US-UK fast reactor irradiation test, were characterized to provide a data base for postirradiation studies. Results from scanning electron microscopy, X-ray diffraction, gas-content and thermal stability characterizations are discussed.

494 **(RISLEY-Trans—4756) Development of breeder reactors in OECD countries.** Pecqueur, M. (UKAEA Risley Nuclear Power Development Establishment). 1983. Translation source information not available . (CONF-8304128—1-Trans). 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83902752.

From 25. anniversary meeting of the Nuclear Energy Agency of the OECD; Lyon, France (21 Apr 1983).

Information is presented concerning the beginning of international co-operation and the electro-nuclear industry; development of the first generation designs; development of breeders; place of breeders in an energy supply strategy; and resources to be employed in the next stages of breeder development.

495 **Two-dimensional modeling of sodium boiling transients in simulated LMFBR fuel bundles.** Rose, S.D.; Dearing, J.F.; Carbajo, J.J.; Levin, A.E.; Montgomery, B.H.; Wantland, J.L. (Oak Ridge National Laboratory, TN (USA)). pp 373-382 of Actes de la conference de Lyon. Vol. 4 (Proceedings of the LMFBR safety topical meeting. Vol. 4). Paris, France; SFEN (1982). (CONF-820704—).

From International topical meeting on LMFBR safety; Lyon, France (18 Jul 1982).

A two-dimensional code for analysis of sodium boiling in LMFBR fuel assemblies has been developed at ORNL. This code, THORAX, has been used to analyze tests in 19- and 61-pin electrically-heated, simulated LMFBR fuel assemblies in the THORS facility. THORAX has simulated well the transient growth of the two-dimensional boiling region and the resulting static flow instability leading to dryout. Extrapolation of results to a full size fuel pin bundle shows that two-dimensional effects are reduced but still significant. The code will be used for analysis of forthcoming tests in the THORS-SHRS Assembly 1 loop, which will include two parallel 19-pin simulated driver bundles.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 487, 559

496 **(NUREG—0750-Vol.16-Index2) Indexes to Nuclear Regulatory Commisson issuances, July-December 1982.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1982. 182p. NTIS, PC A09/MF A01 - GPO. Order Number DE83903087.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. Information elements common to the cases heard and ruled upon are: case name (owners of facility); full text reference (volume and pagination); issuance number; issues raised by appellants; legal citations (cases, regulations, and statutes); name of facility, Docket number; subject matter of issues and/or rulings; type of hearing (for construction permit, operating license, etc.); and type of issuance (memorandum, order, decision, etc.).

497 **(NUREG/CR—2000-Vol.2-No.9) Licensee Event Report (LER) compilation for month of September 1983.** (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 163p. (ORNL/NSIC—200-Vol.2-No.9). NTIS, PC A08/MF A01 - GPO. Order Number DE84001186.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting are described in detail in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. The LER summaries in this report are arranged alphabetically by facility name and then chronlogically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries.

498 **(NUREG/CR—3458) Evaluation of the nuclear-power-plant operator-licensing examination. Final report.** Fullerton, A.M.; Peelle, E.; Reed, J.H.; Morrison, G.W.; Liebowitz, S.J. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 166p. (ORNL/TM—8895). NTIS, PC A08/MF A01 - GPO. Order Number DE84000210.

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The field work included interviews with operator licensing examiners, utility trainers, candidates, and plant management; interviews and discussions with professional; content analysis of the

written portion of 24 control room operator examinations; observation of the conduct of examinations in plants; analysis of data obtained from NRC; and literature searches and reviews. The report includes chapters containing findings from a content analysis of 24 examinations, technical discussions of the concepts of validity and reliability, and the application of these concepts to the control room operator examination. Other chapters discuss the need to develop operator performance measures and the problems associated with this need including problems of influence of performance-shaping factors on control room operator performance. The last half of the report focuses on what could and should be done in the future. The report argues that any new examination must be based on a task analysis, most probably the INPO task analysis. It is also argued that attempts should be made to incorporate methods for measuring operators' problem solving ability in ill-defined situations. Further, it is pointed out that the NRC needs to clarify whether the licensing examination is to be a test of minimal competence or a mastery test, whether the examination system is to also serve the selection function, and whether separate licensing tests are needed for RO's and SRO's. The last chapter presents a model for a new licensing process.

499 **(UNI—2462) Evaluation of Nuclear Facility Decommissioning Projects program: a reference pressurized-water reactor .** Boing, L.E.; Miller, R.L. (eds.). (UNC Nuclear Industries, Inc., Richland, WA (USA)). Aug 1983. Contract AC06-76RL01857. 144p. NTIS MF A01. Order Number DE84001772.

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This document presents, in summary form, generic conceptual information relevant to the decommissioning of a reference pressurized water reactor (PWR) power station. All of the data presented were extracted from NUREG/CR-0130 and arranged in a form that will provide a basis for future comparison studies for the Evaluation of Nuclear Facility Decommissioning Projects (ENFDP) program. During the data extraction process no attempt was made to challenge any of the assumptions used in the original studies nor was any attempt made to update assumed methods or processes to state-of-the-art decommissioning techniques. In a few instances obvious errors were corrected after consultation with the study author.

500 **(UNI-SA—117) Evaluation of Nuclear Facility Decommissioning Projects program.** Baumann, B.L. (United Nuclear Industries, Inc., Richland, WA (USA)). 9 Sep 1983. Contract AC06-76RL01857. 7p. (CONF-8310143—4). NTIS, PC A02/MF A01. Order Number DE84000360.

From 11. NRC water reactor safety research information meeting; Gaithersburg, MD, USA (14 Oct 1983).

The objective of the Evaluation of Nuclear Facility Decommissioning Projects (ENFDP) program is to provide the NRC licensing staff with data which will allow an assessment of radiation exposure during decommissioning and the implementation of ALARA techniques. The data will also provide information to determine the funding level necessary to ensure timely and safe decommissioning operations. Actual decommissioning costs, methods and radiation exposures are compared with those estimated by the Battelle-PNL and ORNL NUREGs on decommissioning. Exposure reduction techniques applied to decommissioning activities to meet ALARA objectives are described. The lessons learned concerning various decommissioning methods are evaluated.

501 **(NE-E—15-2NB-T-Rev.(8-83)) Class 1 Nuclear Components (Supplement to ASME Boiler and Pressure-Vessel Code, Secton III, Subsections NCA and NB).** (Department of Energy, Washington, DC (USA). Office of Nuclear Reactor Programs). Aug 1983. 24p. Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37830.

2108 Economics

REFER ALSO TO CITATION(S) 498

502 **(NUREG/CR—3500) Trends in nuclear power plant capital-investment cost estimates - 1976 to 1982.** Bowers, H.I.; Fuller, L.C.; Myers, M.L. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 64p. (ORNL/TM—8898). NTIS, PC A04/MF A01 - GPO. Order Number DE84001871.

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This report describes trends in power plant capital investment cost estimates over the time period from 1976 to 1982. A review of economic parameters, inflation and escalation rates and cost of money, and a review of cost-size scaling relationships are included. Reference cost estimates are provided for light-water reactor and coal-fired electric power plants based on safety and environmental regulations in effect in January 1982. The sensitivity of the reference cost estimates to numerous economic parameters is analyzed.

2109 Process Heat Reactors

503 **(DOE/SF/02034—T84) HTGR-SC/C Lead Plant availability study.** (Gas-Cooled Reactor Associates, La Jolla, CA (USA)). Aug 1983. Contract AC03-78SF02034. 105p. NTIS MF A01. Order Number DE84000866.

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This report describes the development of availability estimates for the High Temperature Gas-Cooled Reactor steam cycle/cogeneration (HTGR-SC/C) Lead Plant. The HTGR-SC/C Lead Plant is designed to produce both process steam and electric power. The plant can operate in the full electric power mode in the full cogeneration mode, or at any point in between. This study has two objectives: estimate the equivalent availability of the present design for the Lead Plant based on the best current data; and allocate outages for systems and subsystems to obtain a preselected equivalent availability of 80% for electric power generation. These allocations are to serve as design targets for the various systems and subsystems. The report presents a brief description of the Lead Plant followed by a detailed discussion of availability, including terminology, availability allocations, reference data and experience, methodology, the concept of states and capabilities, and the availability results.

504 **(GA-A—17112) 1170-MW(t) HTGR-SC/C application study report: direct steam retorting of oil shale.** Rao, R. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1983. Contract AT03-76SF70046. 51p. NTIS, PC A04/MF A01. Order Number DE84000299.

This report describes the application of a high-temperature gas-cooled reactor (HTGR) that operates in a steam cycle/cogeneration (SC/C) mode to supply process heat, process steam, and electricity for the recovery of oil from shale using a direct steam retorting process. The economic merits of integrating an 1170-MW(t) HTGR-SC/C plant with the direct steam retorting process are assessed, along with those of an indirect gas retorting process assisted by an HTGR-SC/C plant and the standard product oil/gas-fired heat source. The energy requirements for a large commercial direct steam retorting process producing 8590 m^3/D (54,030 B/D) of hydrogenated oil were developed for a bench scale test. The assumed plant location for this present study is northwestern Colorado. Ten modular retorts provide 2.68 x 10^6 kg/h (70,000 T/D) of retorting capacity and yield a net of 8590 m^3/D (54,030 B/D) of hydrogenated shale oil. All mining, process, and support facilities necessary for retorting oil shale are included. A heat balance/steam cycle diagram is included showing the integration of an 1170-MW(t) HTGR-SC/C plant with the process and the cogeneration of 257 MW(e) electric power. A preliminary cost estimate of a commercial direct steam retorting plant shows a price of $41.08 (1983 $, 30-y levelized) per barrel of upgraded shale oil for a 2005 plant startup of an 1170-MW(t) HTGR-SC/C plant.

505 **(GEFR—00669) Reduced-risk HTGR concept for industrial-heat application.** Boardman, C.E.; Lipps, A.J. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jun 1982. Contract AC03-80ET34034. 42p. NTIS, PC A03/MF A01. Order Number DE84000288.

The industrial process heat market has been identified as major market for the High Temperature Gas-Cooled Reactor (HTGR), however, this market introduces stringent availability requirements on the reactor system relative to electric plants which feed a large existing grid. The characteristics and requirements of the industrial heat markets are summarized; the risks associated with serving this market with a single large HTGR will be discussed; and the modular concept, which has the potential to reduce both safety and investment risks, will be described. The reference modular concept described consists of several small, relatively benign nuclear heat sources linked together to supply heat energy to a balance-of-plant incorporating a process gas train/thermochemical pipe line system and a normal steam-electric plant.

506 **(N—8324316) Prototype pant for nuclear process heat (PNP). Verification of Ruhrkohle's AG's interests. Final Report, March 1982.** Duernfeld, R.; Kraut-Giesen, G. (Ruhrkohle Oel und Gas G.m.b.H., Bottrop (Germany, F.R.)). Nov 1982. 40p. (In German and English). (BMFT-FB-T—82-213). NTIS, PC A03/MF A01.

The realization of nuclear coal gasification with a nuclear high temperature reactor (HTR) in accordance with the technical status as well as meeting the existing safety regulations seems to be feasible. Research and development is needed for affirmation of design. The gasification of hard coal basing on the autothermal principal is possible. The design work for the pilot plant should be started immediately, particularly keeping in mind the decision for erection of PNP in 1990. The calculation of production costs in comparison to autothermal gasification processes is promising better economics, if uncertainties of investment calculation are deemed to be neglectable.

22 NUCLEAR REACTOR TECHNOLOGY

507 **(DOE/ER/75094—3) American Nuclear Society eastern regional student conference: transactions 1983.** (Virginia Univ., Charlottesville (USA)). 1983. Contract FG02-83ER75094. 92p. (CONF-8304134—Absts.). NTIS, PC A05/MF A01. Order Number DE84001384.

From ANS eastern regional student conference; Charlottesville, VA, USA (22 Apr 1983).

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Abstracts are presented for 63 papers presented in the following subject areas: health physics and fuel melting; risk assessment; nuclear instrumentation; fuel cycle and waste management; radioisotopes; reactor physics; thermal hydraulics and heat transfer; advanced reactor concepts; and reactor operations. (GHT)

508 **(EGG-M—26282) Real-time interactive simulation: using touch panels, graphics tablets, and video-terminal keyboards.** Venhuizen, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 9p. (CONF-830707—5). NTIS, PC A02/MF A01. Order Number DE84001050.

From Summer computer simulation conference; Vancouver, Canada (11 Jul 1983).

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A Simulation Laboratory utilizing only digital computers for interactive computing must rely on CRT based graphics devices for output devices, and keyboards, graphics tablets, and touch panels, etc., for input devices. The devices all work well, with the combination of a CRT with a touch panel mounted on it as the most flexible combination of input/output devices for interactive simulation.

2201 Theory And Calculation

509 **(CONF-8310104—3) Microscopic beta and gamma data for decay-heat needs.** Dickens, J.K. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01. Order Number DE84002056.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Microscopic beta and gamma data for decay-heat needs are defined as absolute-intensity spectral distributions of beta and gamma rays following radioactive decay of radionuclides created by, or following, the fission process. Four well-known evaluated data files, namely the US ENDF/B-V, the UK UKFPDD-2, the French BDN (for fission products), and the Japanese JNDC Nuclear Data Library, are reviewed. Comments regarding the analyses of experimental data (particularly gamma-ray data) are given; the need for complete beta-ray spectral measurements is emphasized. Suggestions on goals for near-term future experimental measurements are presented. 34 references.

510 **(IKE—28) IKE-contribution to the NEA PWR shielding benchmark for studying the effect of nuclear data uncertainties.** Kicherer, G.; Hehn, G. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Nov 1982. 72p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE83751330.

The paper presents the IKE contribution to the PWR reactor shield benchmark No. 2. The report documents the results of integral target quantity determination performed with ANISN. The cross sections were taken from the recent multigroup data library VIT-IKE-1 where the group structure is identical with VITAMIN-C. The thermal neutron cross section was taken from the 126 thermal neutron group cross-section library THERM-126. The cross-section data and the covariance data library used for hydrogen and iron, are all based on ENDF/B/V data. For the first time a comprehensive cross section and secondary energy distribution (SED) sensitivity and uncertainly analysis for a PWR (Biblis B, 1300 MWsub(el)) was performed with SWANLAKE and SENSIT. The target quantities considered are th $^{54}Fe(n,p)^{54}Mn$ activation rate in the barrel material near the surveillance capsules and in the pressure vessel cladding, the iron displacement rate at the inner edge of the pressure vessel, the gamma heating rate at the inner edge of core baffle, at the core barrel, pressure vessel and concrete shield and the biological neutron- and gamma dose rate at the outer side of the concrete shield.

511 **(KFK—3537) PREPRO - a preprocessor code for SSYST input.** Borgwaldt, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). May 1983. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83751319.

A global input preprocessor PREPRO has been developed as a support tool for the code-system SSYST. Its purpose is to simplify writing and checking large input decks for the code-system SSYST. The preprocessor has the following capabilities: Input for programmes only loosely coupled to the code-system SSYST is copied directly to the output file. Input for all regular, fully integrated SSYST modules is accepted in formatted, free-format or symbolic form and is converted to standard SSYST input formats. In addition, the input is extensively checked for formal correctness, and the list of required modules for executing the input is evaluated. The report gives an outline of the way PREPRO operates and instructions how to use it. To demonstrate usage, 2 sample applications have been included in the Appendices A to D.

512 **Solving the critical-core neutronics problem.** Vondy, D.R. (Oak Ridge National Lab., TN (USA)). *Annals of Nuclear Energy;* **10**: No. 1, 1-17(1983).

The nuclear reactor-core neutronics problem for the critical state is discussed. Methods are described that have evolved for routine application in the assessment of core performance. Of prime interest are the conditions associated with the critical state, and supporting methods development is challenged to solve these problems. Special procedures have been found to be necessary to gener-

ate reliable information at a reasonable computation cost. Techniques that have proven useful are discussed, as well as the difficulties that have been experienced in applying multidimensional diffusion theory.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 246, 501, 773, 880

513 **(BONN-HE—83-6) Microcomputer development at Bonn and its application in FADC data reduction.** Mertens, V.; Schmitt, H. von der. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Apr 1983. 21p. (CONF-830353—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751325.

From Meeting on the impact of specialized processors in elementary particle physics; Padua, Italy (23 Mar 1983).

With the 16/32-bit microprocessors 68K, high CPU performance (comparable to a VAX 11/780) and large address space (several Mbytes) become available for data processing on the crate level. Some software effort is necessary to take full advantage of such devices. For the Camac environment, an ACC (auxiliary crate controller) based on the 68K has been built at Bonn. Fortran-77 with specific support of real-time applications in the crate environment is made available as portable cross software. A comprehensive compiler-writing language has been developed and employed for this purpose, offering the flexibility to adapt the compiler to specific hardware conditions. A first application of this hardware/software system in FADC data reduction is described.

514 **(ETEC-TDR—82-2) Snubber qualification and test requirements.** Onesto, A.T.; Larson, D.A. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 2 May 1983. Contract AC03-76SF00700. 238p. NTIS, PC A11/MF A01. Order Number DE84000954.

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The use of snubbers for safety related piping systems has increased significantly during the last decade. A corresponding increase in snubber requirements (criteria) has also occurred. A review of these criteria indicates inconsistencies and contradictions, and reflects how rapidly knowledge and experience has been gained and applied. This study reviews and summarizes existing criteria, illustrates inconsistencies and recommends research to resolve conflicts.

515 **(N—8321381) Unstable fracture from stable fibrous crack growth, part 3.** Kanazawa, T.; Machida, S.; Aihara, S. (British Library, Boston Spa. Lending Div.). 1983. 14p. Avail: British Library Lending Div., Boston Spa,;Engl.

Cracking caused by stress corrosion, etc. is known to occur in chemical or nuclear power plant pipework, and one of the ways of evaluating the safety of plants containing such pipes is to use the leak before break (LBB) concept. The basic assumption of the LBB concept is that, should ductile fracture be initiated from a crack in the pipes, operation can still be halted in time to avoid loss of function of the plant as a whole by detecting the leakage of internal fluid, provided that fracture growth is stable until the crack penetrates the pipe wall. A method of deducing stability or instability of ductile crack growth in surface notched plates using tearing instability theory is investigated.

516 **(NUREG/CR—3464) Application of fracture-proof design methods using tearing-instability theory to nuclear piping postulating circumferential through-wall cracks.** Paris, P.C.; Tada, H. (Del Research Corp., St. Louis, MO (USA)). Sep 1983. 205p. NTIS, PC A10/MF A01 - GPO $6.00. Order Number DE84900051.

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This report presents methods of applying tearing instability analysis to large circumferential through-wall cracks in piping to demonstrate cases of adequate ductility to avoid double ended break. The first part gives results of applying simplified rigid-plastic cracked section analysis to some typical piping systems and subsequently gives some additional refinements of this type of analysis. The second part presents full elastic-plastic cracked section analysis which demonstrates the adequacy of rigid-plastic analysis for most cases and provides the methodology where elastic-plastic analysis is required. The results combined with adequate treatment of material property data and other deformation limiting and load limiting aspects of as-built piping systems, provides a complete analysis of subject.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 1147

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 246, 880, 918

517 **(DPST—82-340) Environmental issues associated with R Reactor renovation and startup.** Marter, W.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 23 Feb 1982. Contract AC09-76SR00001. 9p. NTIS, PC A02/MF A01. Order Number DE84001755.

This memorandum identifies the more significant environmental issues that would be associated with renovation and startup of R Reactor to meet future demands for nuclear weapon materials. Some key environmental issues identified are: potential occupational radiation exposures associated with repairing the leaks in the reactor nozzles and thermal shield tanks and with renovating the disassembly basin facilities; the impacts of constructing additional cooling water pumping capacity; the effect of increased pumping on impingement and entrainment at the pump houses; thermal effects on the R Canal-precooler pond-Par Pond ecosystem from increased discharge of cooling water; and effects of increased water flow in Lower Three Runs Creek on biota and on cesium-137 remobilization.

518 **(EGG—2273) Statistical study of low-level radioactive waste generated by US nuclear power plants from 1973 to 1981.** Naretto, C.J.; Semler, T.T.; Everette, S.E.; Levin, G.B. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1983. Contract AC07-76ID01570. 24p. NTIS, PC E03/MF A01. Order Number DE84002297.

Includes 3 sheets of 24x reduction microfiche.

The amount of low-level radioactive waste generated in the US is of concern to those involved with and responsible for radioactive waste management and policy formulation. One of the largest sources of low-level radioactive waste (LLW) in the US is the commercial nuclear power reactor. In previous studies it has been conjectured that boiling water reactors (BWRs) and pressurized water reactors (PWRs) produce constant but differing amounts of LLW per megawatt-electric of rated power. The present study is based on the historic amounts of LLW shipped yearly from commercial BWRs and PWRs, as recorded in the National Low Level Radioactive Waste Data Base System, and thus is truly representative of LLW generation characteristics. The results of linear time series regression analysis of the LLW generation rates were examined to determine the adequacy of this simple model and to determine trends in LLW generation with respect to time. According to this analysis, LLW generation per megawatt-electric tends to increase as a function of time after startup for both BWRs and PWRs. While the linear model was often quite good for individual nuclear reactors or nuclear reactor stations, it could not account for the cyclic behavior and spiking that were often noted in the actual yearly LLW generation rates. For a PWR, the rate of LLW volume generated, in cubic meters per year per megawatt-electric (rated), was best approximated by 0.27 + 0.071 x years from startup. For a BWR, the LLW volume in cubic meters per year per megawatt electric (rated) is estimated by 1.25 + 0.066 x years from startup. Suggestions are made for model improvements and various other reactor groupings are investigated.

519 (IAEA-SR—72, pp 471-499) **Removal of carbon-14 from gaseous streams.** Cheh, C.H.; Glass, R.W.; Chew, V.S. (Ontario Hydro Research Lab., Toronto (Canada)). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/7).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

The two major sources of carbon-14 in CANDU reactors are the annulus gas system (if nitrogen is used as the annulus gas) and moderator system. A dry process to remove carbon-14 as $^{14}CO_2$ from gaseous streams at ambient temperatures was developed at Ontario Hydro Research Division. Bench and pilot scale systems were assembled to study the process. Gas streams at flow rates up to 200 1/min. with carbon dioxide concentrations from 5 to 50,000 u1/1 were treated. The effect of gas temperature, flow rate, humidity and reactor vessel geometry on the reaction was studied and a mechanism for the reaction is discussed in the paper. Decontamination factors as high as 10^4 were achieved for the high carbon dioxide concentration studied and the outlet carbon dioxide concentrations were below 1 u1/1 for the inlet concentrations between 3 and 30 u1/1. The pilot system was tested for over 1000 hours under conditions similar to the moderator cover-gas system operating under normal as well as upset conditions. The performance of the pilot system did not change throughout the long period of testing. Carbon-14 is fixed in a stable solid form in the process suitable for disposal. Although the process is being developed to remove carbon-14 from the moderator cover-gas in CANDU reactors, it can also be applied to nitrogen annulus gas systems with some modifications. The application of the system for off-gas treatment in fuel reprocessing plants is also being considered.

520 **(NUREG—1011-F) Final environmental statement related to steam-generator repair at Point Beach Nuclear Plant, Unit No. 1 (Docket No. 50-266).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1983. 63p. NTIS, PC A04/MF A01 - GPO $4.50. Order Number DE84900058.

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The staff hhas considered the environental impacts and economic costs of the proposed steam generator repair at the Point Beach Nuclear Plant, Unit No. 1 along with reasonable alternatives to the proposed action. The staff has concluded that the proposed repair will not significantly affect the quality of the human environment and that there are no preferable alternatives to the proposed action. Furthermore, any impacts from the repair program are outweighed by its benefits.

521 **(PNL-SA—11459) Monitoring nuclear facilities using Landsat-4 thermatic mapper data.** Wukelic, G.W.; Foote, H.P.; Pendergast, M.M. (Pacific Northwest Lab., Richland, WA (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1983. Contract AC06-76RL01830;AC09-76SR00001. 15p. (CONF-830847—5). NTIS, PC A02/MF A01. Order Number DE84002586.

From Energy resource management '83; San Francisco, CA, USA (23 Aug 1983).

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This paper discusses the initial results of evaluating the potential use of TM Thermal data as a means to improve modeling and monitoring of temperature conditions in a typical closed loop water cooling system for a nuclear reactor. The thermal data and other TM multispectral data from Landsat offer the possibility to provide periodic surveys of surface water cooling systems with the purpose of updating thermal calibration on a seasonal basis, monitoring system efficiency for suspected or unknown changes within the confined waters, and planning expansion or experiments of the system in response to reactor operational needs. The Landsat TM should be considered as a complement rather than a substitute for the more detailed surveys afforded by aircraft borne sensors. By judiciously combining both aerial and satellite surveys, resulting data can be more economical and effective than using the products of only one of the two sensing systems. Moreover, the Landsat TM is one of a family of new generation satellite remote sensing systems which feature improved spatial resolution, wider spectral coverage, and expanded radiometric range. As these advanced systems become operational in the near future, significant implications exist for assisting environmental monitoring and ecological studies that would be of interest to organizations responsible for these activities at major DOE installations.

522 **American National Standard: for evaluation of ground-water supply for nuclear power sites.** La Grange Park, IL; American Nuclear Society (1980). 25p. (ANSI/ANS—2.9-1980). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $24.00.

This standard presents guidelines for the determination of the availability of ground water supplies for nuclear power plant operations with respect to both safety and non-safety related aspects.

523 **American National Standard: for gaseous radioactive-waste-processing systems for light-water-reactor plants.** La Grange Park, IL; American Nuclear Society (1979). 56p. (ANSI/ANS—55.4-1979). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $36.00.

This standard sets forth minimum design, construction and performance requirements, with due consideration for operation, for Gaseous Radioactive Waste Processing Systems for light water reactor plants. It is applicable for routine operation including design basis fuel leakage and other design basis occurrences. For the purpose of this standard, the Boiling Water Reactor (BWR) Gaseous Radioactive Waste Processing Systems begin at the point of discharge from the main condenser air removal equipment, the main condenser mechanical vacuum pump and the turbine steam packing exhauster. For Pressurized Water Reactors (PWRs), the Gaseous Radioactive Waste Processing Systems begin at the point of discharge from plant components, systems and equipment designed for the removal of radioactive gas from the reactor coolant system. The standard also addresses the release of radioactive materials in gaseous discharges from other plant systems. The systems terminate at the point of introduction into the plant ventilation exhaust stream(s). The Gaseous Radioactive Waste Processing Systems are not safety systems nor do they contain components that are safety class.

524 **American National Standard: design objectives for and monitoring of systems controlling research-reactor effluents.** La Grange Park, IL; American Nuclear Society (1977). 9p. (ANSI/ANS—15.12-1977). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $15.00.

This Standard establishes design objectives for systems controlling the release of radioactive materials from research reactors during normal operation. It also defines acceptable monitoring techniques. The basic objectives are listed below.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 220, 488, 491, 492, 524, 532, 535, 561, 575, 584, 589, 592, 902

525 **(HEDL-SA—2920) Application of mass spectrometry to fuels and materials testing at FFTF.** Plucinski, C.E.; Goheen, M.W.; McCown, J.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1983. Contract AC06-76FF02170. 8p. (CONF-831025—9). NTIS, PC A02/MF A01. Order Number DE84001465.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The Fast Flux Test Facility (FFTF) is a sodium cooled reactor operated for the Department of Energy by Westinghouse Hanford Company. In FFTF the 78 fuel pin assemblies have been tagged with a unique combination of Kr and Xe isotopes. In addition to fuel pin assemblies, other test assemblies can also be similarly tagged as in the Materials Open Test Assembly (MOTA). During power operations leaks are monitored by single channel gamma analyzers in the reactor cover gas system. When radioactive Kr and Xe isotopes are detected a gas tag sample trap (GTST) is used to take a sample of the reactor cover gas, the Kr and Xe are concentration, and isotopic analysis is obtained by mass spectrometry.

526 **(PNL-TR—431-Vol.2) Applications of gammametry to the study of a plate-type fuel.** Carteret, Y.; Schley, R.; Simonet, G. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center). Oct 1983. Contract AC06-76RL01830. Translation source information not available . (CONF-791051—31-Tr.). 30p. NTIS, PC A03/MF A01. Order Number DE84001198.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The program of experimental irradiations undertaken by the French Atomic Energy Commission (CEA) on the CARAMEL plate-type fuel has been followed by gamma spectrometry together with other techniques. The qualitative study of the distribution of fission products constitutes a source of information on the behavior of the fuel (temperature and structure) and permits prediction of its limits of use. The study of the evolution of a burnable poison - gadolinium - constitutes an application of this technique.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 273

2209 Reactor Safety

527 **(ANL/NESC—1020) BACFIRE: common cause failure analysis.** Cate, C.L.; Fussell, J.B. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). [nd]. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049006.

Portions are illegible in microfiche products30K bytes of memory are required for execution; OS/MVT.

BACFIRE, designed to aid in common cause failure analysis, searches among the basic events of a minimal cut set of the system logic model for common potential causes of failure. The potential cause of failure is called a qualitative failure characteristic. The algorithm searches qualitative failure characteristics (that are part of the program input) of the basic events contained in a set to find those characteristics common to all basic events. This search is repeated for all cut sets input to the program. Common cause failure analysis is thereby performed without inclusion of secondary failures in the system logic model. By using BACFIRE, a common cause failure analysis can be added to an existing system safety and reliability analysis. BACFIRE searches the qualitative failure characteristics of the basic events contained in the fault tree minimal cut set to find those characteristics common to all basic events by either of two criteria. The first criterion can be met if all the basic events in a minimal cut set are associated by a condition which alone may increase the probability of multiple component malfunction. The second criterion is met if all the basic events in a minimal cut set are susceptible to the same secondary failure cause and are located in the same domain for that cause of secondary failure.

528 **(BNL-NUREG—33096) Aspects of microwave-heating uniformity.** Ginsberg, T.; Makowitz, H. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 26p. (CONF-831111—4). NTIS, PC A03/MF A01 - GPO. Order Number DE83014103.

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

Portions are illegible in microfiche products.

Interest has been shown in the field of nuclear reactor safety in the use of microwave heating to simulate the nuclear heat source. The objective of the investigation reported here was to evaluate the usefulness of microwave dielectric heating as a simulator of the nuclear heat source in experiments which simulate the process of boiling of molten mixtures of nuclear fuel and steel. This paper summarizes the results of studies of several aspects of energy deposition in dielectric liquid samples which are exposed to microwave radiation.

529 **(CEA-CONF—6626) Study of plant running in an accidental or incidental situation.** Montmayeul, R.; Rodenas, A.; Vittet, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1982. 10p. (In French). (DSN—585; CONF-8210169—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703737.

From 18. congress of the French Society of Ergonomy on imaging and applications; Rocquencourt, France (11 Oct 1982).

A method used in the nuclear industry to study plant running in an accidental situation with the help of a training simulator is presented. A description is given of the working situation studied, the test methods and the processing. Mention is made of subsequent research prospects.

530 **(CONF-830901—9) Calculation of the limiting CESSAR Feedwater Line-Break and Steam Line-Break transients.** Peeler, G.B.; Kennedy, M.F.; Caraher, D.L.; Guttmann, J.; Chung, K.S. (Argonne National Lab., IL (USA)). 1983. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01. Order Number DE84000601.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

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Argonne National Laboratory (ANL), under contract to the Nuclear Regulatory Commission, performed audit calculations of the limiting Feedwater Line Break (FLB) and Steam Line Break (SLB) transients presented in the CESSAR FSAR. The results of the FLB and SLB calculations are discussed.

531 **(DOE/TIC—4633) Nuclear criticality safety training: guidelines for DOE contractors.** Crowell, M.R. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1983. Contract AC05-76OR00033. 33p. (ORAU—213). NTIS, PC A03/MF A01. Order Number DE84001890.

The DOE Order 5480.1A, Chapter V, Safety of Nuclear Facilities, establishes safety procedures and requirements for DOE nuclear facilities. This guide has been developed as an aid to implementing the Chapter V requirements pertaining to nuclear criticality safety training. The guide outlines relevant conceptual knowledge and demonstrated good practices in job performance. It addresses training program operations requirements in the areas of employee evaluations, employee training records, training program evaluations, and training program records. It also suggests appropriate feedback mechanisms for criticality safety training program improvement. The emphasis is on academic rather than hands-on training. This allows a decoupling of these guidelines from specific facilities. It would be unrealistic to dictate a universal program of training because of the wide variation of operations, levels of experience, and work environments among DOE contractors and facilities. Hence, these guidelines do not address the actual implementation of a nuclear criticality safety training program, but rather they outline the general characteristics that should be included.

532 **(EGG-M—04683) LOFT fuel-rod-transient DNB probability density function studies.** Atkinson, S.A.; Fisher, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 24p. (CONF-830702—28). NTIS, PC A02/MF A01. Order Number DE84001048.

From 21. ASME/AIChE national heat transfer conference; Seattle, WA, USA (24 Jul 1983).

Significantly improved DNB safety margins were calculated for LOFT reactor fuel rods by use of probability density functions (PDF) for transient MDNBR. Applicability and sensitivity studies determined that the PDF and resulting nominal MDNBR limits are stable, applicable over a wide range of potential input parameters, and applicable to most transients.

533 **(EGG-M—08283) PBF Severe Fuel-Damage Program: results and comparison to analysis.** MacDonald, P.E.; Buescher, B.J.; Hobbins, R.R.; McCardell, R.K.; Gruen, G.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 5p. (CONF-830816—44). NTIS, PC A02/MF A01. Order Number DE84000896.

From International meeting on light-water reactor severe accident evaluation; Cambridge, MA, USA (28 Aug 1983).

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The United States Nuclear Regulatory Commission has initiated a severe fuel-damage research program in the Power Burst Facility (PBF) to investigate fuel-rod and core response, and fission-product and hydrogen release and transport under degraded-core-cooling accident conditions. This paper presents a description of Phase I of the PBF Severe Fuel Damage Program, discusses the results of the first experiment, and compares those results with analysis performed using the TRAC-BD1 computer code.

534 **(EGG-M—08483) TMI-2 core damage: a summary of present knowledge.** Owen, D.E.; Mason, R.E.; Meininger, R.D.; Franz, W.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 8p. (CONF-830816—41). NTIS, PC A02/MF A01. Order Number DE84000892.

From International meeting on light-water reactor severe accident evaluation; Cambridge, MA, USA (28 Aug 1983).

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Extensive fuel damage (oxidation and fragmentation) has occurred and the top ~ 1.5 m of the center portion of the TMI-2 core has relocated. The fuel fragmentation extends outward to slightly beyond one-half the core radius in the direction examined by the CCTV camera. While the radial extent of core fragmentation in other directions was not directly observed, control and spider drop data and in-core instrument data suggest that the core void is roughly symmetrical, although there are a few indications of severe fuel damage extending to the core periphery. The core material fragmented into a broad range of particle sizes, extending down to a few microns. APSR movement data, the observation of damaged fuel assemblies hanging unsupported from the bottom of the reactor upper plenum structure, and the observation of once-molten stainless steel immediately above the active core indicate high temperatures (up to at least 1720 K) extended to the very top of the core. The relative lack of damage to the underside of the plenum structure implies a sharp temperature demarcation at the core/plenum interface. Filter debris and leadscrew deposit analyses indicate extensive high temperature core materials interaction, melting of the Ag-In-Cd control material, and transport of particulate control material to the plenum and out of the vessel.

535 **(EGG-M—08883) LOFT uncertainty-analysis methodology .** Lassahn, G.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 10p. (CONF-830702—27). NTIS, PC A02/MF A01. Order Number DE84000563.

From 21. ASME/AIChE national heat transfer conference; Seattle, WA, USA (24 Jul 1983).

The methodology used for uncertainty analyses of measurements in the Loss-of-Fluid Test (LOFT) nuclear reactor safety research program is described and compared with other methodologies established for performing uncertainty analyses.

536 **(EGG-M—14582) Fuel axial relocation in ballooning fuel rods.** Siefken, L.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 11p. (CONF-830805—58). NTIS, PC A02/MF A01. Order Number DE84000367.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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Fuel movement, in the longitudinal direction in ballooning fuel rods, shifts the position of heat generation and may cause an increase in cladding temperature in the ballooning region. This paper summarizes the axial fuel relocation data obtained in fuel rod tests conducted in the United States and the Federal Republic of Germany, describes a model for calculating fuel axial relocation, and gives a quantitative analysis of the impact of fuel relocation on cladding temperature. The amount of fuel relocation in 18 ballooned fuel rods was determined from neutron radiographs, niobium gamma decay counts, and photomicrographs. The fuel rods had burnups in the range of 0 to 35,000 MWd/t and cladding hoop strains varying from 0 to 72%.

537 **(EGG-M—16182) HDR steel-containment vessel dynamic inertance tests.** Arendts, J.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 13p. (CONF-830805—56). NTIS, PC A02/MF A01. Order Number DE84000891.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

Modal (inertance) tests were conducted on two vessels at the Heissdampfreaktor (HDR) facility located 25 kilometers east of Frankfurt, Federal Republic of Germany. The specific purpose of the tests was to determine the modal properties (frequencies, mode shapes and associated damping ratios) of the test vessels over a frequency range of 1 to at least 33 hertz (Hz) using either an impulse hammer or shaker as a source of input excitation. The results of these tests are intended for use by the US Nuclear Regulatory Commission (NRC) in developing standards for modeling similar structures. Excitation or input forces together with measured vessel responses were processed by a digital modal analyzer. Frequency response functions and associated data were determined and stored on magnetic disks while at HDR. These results were then further processed for determination of the modal properties. A large number of relatively uniformly distributed modal frequencies with associated damping ratios from 2% to 4% of critical were found from evaluation of the frequency response functions.

538 **(EGG-M—16283) SCDAP: a computer code for analyzing light-water-reactor severe core damage.** Allison, C.M.; Carlson, E.R.; Smith, R.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 6p. (CONF-830816—45). NTIS, PC A02/MF A01. Order Number DE84000901.

From International meeting on light-water reactor severe accident evaluation; Cambridge, MA, USA (28 Aug 1983).

The Severe Core Damage Analysis Package (SCDAP) computer code is being developed at the Idaho National Engineering Laboratory under the sponsorship of the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. SCDAP models the progression of light water reactor core damage including core heatup, core disruption, debris formation, debris heatup, and debris melting. SCDAP is being used to help identify and understand the phenomena that control core behavior during a severe accident, to help quantify uncertainties in risk assessment analysis, and to support planning and interpretation of severe fuel damage experiments and data.

539 **(EGG-M—16383) TMI-2 core examination.** Hobbins, R.R.; MacDonald, P.E.; Owen, D.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 9p. (CONF-830816—39). NTIS, PC A02/MF A01. Order Number DE84000888.

From International meeting on light-water reactor severe accident evaluation; Cambridge, MA, USA (28 Aug 1983).

The examination of the damaged core at the Three Mile Island Unit 2 (TMI-2) reactor is structured to address the following safety issues: fission product release, transport, and deposition; core coolability; containment integrity; and recriticality during severe accidents; as well as zircaloy cladding ballooning and oxidation during so-called design basis accidents. The numbers of TMI-2 components or samples to be examined, the priority of each examination, the safety issue addressed by each examination, the principal examination techniques to be employed, and the data to be obtained and the principal uses of the data are discussed in this paper.

540 **(EGG-M—16483) Severe Fuel-Damage Scoping Test post-irradiation examination results.** Cook, B.A.; Ploger, S.A.; Mason, R.E.; Tow, D.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 5p. (CONF-830816—46). NTIS, PC A02/MF A01. Order Number DE84000890.

From International meeting on light-water reactor severe accident evaluation; Cambridge, MA, USA (28 Aug 1983).

The fuel bundle from the Severe Fuel Damage Scoping Test, conducted in the Power Burst Facility as part of the international Severe Fuel Damage Research Program, was examined post-test. This paper presents the results of the nondestructive portion of the examination, including gross gamma scanning, neutron radiog-

raphy, and tomographic reconstruction of cross sections through the bundle using the neutron radiographs.

541 **(EGG-M—17582) Description and assessment of structural and temperature models in the FRAP-T6 code.** Siefken, L.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 12p. (CONF-830805—57). NTIS, PC A02/MF A01. Order Number DE84000836.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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The FRAP-T6 code was developed at the Idaho National Engineering Laboratory (INEL) for the purpose of calculating the transient performance of light water reactor fuel rods during reactor transients ranging from mild operational transients to severe hypothetical loss-of-coolant accidents. An important application of the FRAP-T6 code is to calculate the structural performance of fuel rod cladding. The capabilities of the FRAP-T6 code are assessed by comparisons of code calculations with the measurements of several hundred in-pile experiments on fuel rods. The results of the assessments show that the code accurately and efficiently models the structural and thermal response of fuel rods.

542 **(EGG-M—18983) Nonequilibrium constitutive models for RELAP5/MOD2.** Lin, J.C.; Trapp, J.A.; Riemke, R.A.; Ransom, V.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1983. Contract AC07-76ID01570. 16p. (CONF-830901—18). NTIS, PC A02/MF A01. Order Number DE84001648.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

RELAP5/MOD2 is a new version of RELAP5 containing improved modeling features that provide a generic pressurized-water transient simulation capability. In particular, the nonequilibrium modeling capability has been generalized to include conditions that occur in operational transients including repressurization and emergency-feed-water injection with loss-of-coolant accidents. The improvements include addition of a second energy equation to the hydrodynamic model, addition of nonequilibrium heat-transfer models, and the associated nonequilibrium vapor-generation models. The objective of this paper is to describe these models and to report the developmental assessment results obtained from similar of several separate effects experiments. The assessment shows that RELAP5 calculated results are in good agreement with data and the nonequilibrium phenomena are properly modeled.

543 **(EUR—6993) Pre-test prediction for LOBI test A1-04 (PREX test).** Staedtke, H.; Kolar, W. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1982. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE83703738.

This report contains the pre-test prediction for the first LOBI test A1-04, which has been chosen as Pre-Prediction Exercise (LOBI-PREX). The test A1-04 will be a simulation of a nearly 200% double ended off-set shear break in the cold leg of the primary system of a four loop PWR. The prediction was performed with the RELAP4/Mod 6 computer code. The report gives the test specification (initial and boundary conditions), a brief description of the RELAP4 model used for the LOBI test facility and a short analysis of the predicted system behaviour. A complete RELAP4 input listing is given in Appendix A.

544 **(EUR—7765) BUSH: A computer code for calculating steady state heat transfer in LWR rod bundles under accident conditions.** Shepherd, I.M. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1982. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE83703739.

The computer code BUSH has been developed for the calculation of steady state heat transfer in a rod bundle. For a given power, flow and geometry it can calculate the temperatures in the rods, coolant and shroud assuming that at any axial level each rod can be described by one temperature and the coolant fluid is also radially uniform at this level. Heat transfer by convection and radiation are handled and the geometry is flexible enough to model nearly all types of envisaged shroud design for the SUPERSARA test series. The modular way in which BUSH has been written makes it suitable for future development, either within the present BUSH framework or as part of a more advanced code.

545 **(EUR—8018) Comparative analysis of a hypothetical 0.1 $/SEC transient overpower accident in an irradiated LMFBR core using different computer models.** Cacciabue, P.C.; de Fremont, R.; Renard, A. (Commission of the European Communities, Luxembourg. Center for Information and Documentation). 1982. 188p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE83703740.

The Report gives the results of comparative calculations performed by the Whole Core Accident Codes Group which is a subgroup of the Safety Working Group of the Fast Reactor Coordinating Committee for a hypothetical transient overpower accident in an irradiated LMFBR core. Different computer codes from members of the European Community and the United States were used. The calculations are based on a Benchmark problem, using commonly agreed input data for the most important phenomena, such as the fuel pin failure threshold, FCI parameters, etc. Beside this, results with alternative assumptions for theoretical modelling are presented with the scope to show in a parametric way the influence of more advanced modelling capabilities and/or better (so-called best estimate) input data for the most important phenomena on the accident sequences.

546 **(GKSS—83/E/9) Investigations of particle transport mechanism during a blowdown test at the HDR.** Kreubig, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751327.

Experiments have been performed in the HDR-Containment focussed on transport mechanism of solid particles after a loss of coolant accident. For this purpose at several locations marked particles of various size have been deposed before a LOCA-experiment and their distribution after the experiment investigated. The complex geometry of the HDR-Containment has many floors for deposition of solid particles, so no particles were drained to the containment sump.

547 **(GRS-F—126) List of reports from BMFT, CEA, EPRI, JSTA and USNRC concerning reactor safety research.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1983. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83751340.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of Amerika concerning special Problems in the field of Reactor Safety Research. The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programm of the BMFT, reporting organization. The list of reports appears quarterly.

548 **(JAERI-M—82-060) Fault tree analysis on BWR core spray system.** Watanabe, Norio. (Japan Atomic Energy Research Inst., Tokyo). Jun 1982. 112p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE83703741.

Fault Trees which describe the failure modes for the Core Spray System function in the Browns Ferry Nuclear Plant (BWR 1065MWe) were developed qualitatively and quantitatively. The unavailability for the Core Spray System was estimated to be 1.2 x 10^{-3}/demand. It was found that the miscalibration of four reactor pressure sensors or the failure to open of the two inboard valves (FCV 75-25 and 75-53) could reduce system reliability significantly. It was recommended that the pressure sensors would be calibrated independently. The introduction of the redundant inboard valves could improve the system reliability. Thus this analysis method was verified useful for system analysis. The detailed test and maintenance manual and the informations on the control logic circuits of each active component are necessary for further analysis.

549 **(K/PS—5022) Applications of laser spectroscopy for species determination in fission product release experiments.** McCulla, W.H.; Nelson, G.E.; Lorenz, R.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 7p. (CONF-831025—11). NTIS, PC A02/MF A01. Order Number DE84001783.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Identification of vapor-phase species and the kinetics of their reactions in simulated LWR nuclear accidents are important in predicting the ultimate fate of volatile fission products. Laser spectroscopic techniques such as laser Raman and laser-induced fluorescence (LIF) are valuable tools in determining molecular species and concentrations from these experiments. Equipment capable of vapor-phase measurements up to 1500°K is described. These techniques have been applied to molecular iodine and CsI vapors. The application of LIF to iodine vapor is reviewed and the problems associated with high-temperature concentration measurements (to 1200°K) are discussed. The characterization of the LIF spectrum of CsI vapor at 1100°K is presented.

550 **(KFK—3561) Reliability study for the containment of a pressurized water reactor using probabilistic fracture mechanics. Pt. 3.** Haeberer, R.; Brueckner, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Jun 1983. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83751338.

A reliability analysis is performed by the methods of probabilistic fracture mechanics for the steel containment of a pressurized water reactor during a loss of coolant accident. A model is developed describing the elastic-plastic failure of the embedded cracks found during ultrasonic inspection. In the probabilistic analysis the effect of this fracture mechanical model on the predicted failure probabilites and on the failure mechanisms is examined.

551 **(LA—9795-MS) NDA measurement of the demineralizers at TMI-2.** Phillips, J.R.; Halbig, J.K.; Rinard, P.M.; Bosler, G.E. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01. Order Number DE84002295.

Nondestructive measurements were performed to estimate the amount of fuel material deposited in the two demineralizers during the accident at TMI-2. Gross gamma-ray measurements were used to characterize the horizontal and vertical activity profiles of gamma-emitting fission products in Demineralizer A. A Be(γ,n) detector, sensitive to gamma rays with energies above 1.667 MeV, was used to estimate the quantity of ^{144}Ce to ^{144}Pr present, which was assumed to be directly proportional to the amount of fuel present. A variety of source distributions was modeled using the Los Alamos Monte Carlo transport code to calculate the fraction of gamma rays that would strike the detector with energies above the 1.667-MeV threshold. The estimated amount of uranium depends on the assumed source distribution and material density as well as on the specific orientation of the detector. We estimate an upper limit to be in the range of 7 kg and a lower limit to be 2 kg for Demineralizer A. Demineralizer B is estimated to contain approximately 0.7 kg of uranium.

552 **(LA-UR—83-2719) TRAC analysis of the Crystal River Unit-3 Plant transient of February 26, 1980.** Coddington, P.; Willcutt, G.J.E. Jr. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 12p. (CONF-830901—12). NTIS, PC A02/MF A01. Order Number DE84001327.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

This paper describes the application of the TRAC-PD2 and TRAC-PF1 codes to analyze the Crystal River transient. The PD2 and PF1 analyses used the three-dimensional and one-dimensional vessel models, respectively. Both calculations predicted the plant depressurization caused by the open PORV and the subsequent repressurization caused by closing the PORV and continuing high-pressure injection flow. Also, natural circulation was calculated in loop B following reestablishment of feedwater to the loop-B steam generator. After system repressurization, the codes calculated that pressure was relieved through the safety valves, and an intermittent flow occurred in loop A because of high-pressure-injection-driven density variations.

553 **(LA-UR—83-2753) TRAC calculations of overcooling transients in PWRs for pressurized thermal-shock analysis.** Ireland, J.R.; Boyack, B.E. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 16p. (CONF-830901—13). NTIS, PC A02/MF A01. Order Number DE84001315.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

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This paper briefly describes the overall pressurized thermal shock (PTS) program at Los Alamos with emphasis on TRAC-PF1 calculations of severe overcooling transients in pressurized water reactors (PWRs). Overcooling transients for both the Oconee-1 and Calvert Cliffs-1 nuclear plants have been performed. A summary of results for several calculations are presented for the Oconee-1 PWR along with detailed discussions of two of the most severe overcooling transients predicted [main steam-line break and turbine-bypass valve (TBV) failures]. The calculations performed were plant specific in that details of both the primary and secondary sides were modeled in addition to a detailed model of the plant integrated control system (ICS). For the Oconee-1 main steam-line break transient, a minimum downcomer fluid temperature of ~ 405°K was predicted. For the transient involving the failure of one bank of TBVs to close after initially opening following reactor and turbine trips, and extrapolated downcomer fluid temperature of ~ 365°K was estimated. The latter temperature is at the nil-ductility temperature (NDT) limit (~ 365°K) for Oconee-1.

554 **(LA-UR—83-2780) TRAC-PF1 analysis of LOFT steam-generator feedwater transient test L9-1.** Meier, J.K. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 10p. (CONF-830901—14). NTIS, PC A02/MF A01. Order Number DE84001303.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

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The Transient Reactor Analysis Code (TRAC-PF1) calculations were compared to test data from Loss-of-Fluid Test (LOFT) L9-1, which was a loss-of-feedwater transient. This paper includes descriptions of the test and the TRAC input and compares the TRAC-calculated results with the test data. We conclude that the code predicted the experiment well, given the uncertainties in the boundary conditions. The analysis indicates the need to model all the flow paths and heat structures, and to improve the TRAC wall condensation heat-transfer model.

555 **(LA-UR—83-2786) Small-break LOCA recovery in B & W plants.** Henninger, R.J.; Ireland, J.R.; DeMuth, N.S. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-830901—17). NTIS, PC A02/MF A01. Order Number DE84001316.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

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A break of approximately 0.0012 m^2 in the cold leg of a B & W plant results in an interruption of natural circulation when steam accumulates in the hot-leg U-bend. A small-break loss-of-coolant accident of this size was simulated by TRAC-PF1 to evaluate strategies for recovery and for re-establishing natural circulation. In the absence of operator action, core cooling occurs when water supplied by the high-pressure-injection system boils, then is discharged through the break. Raising the steam-generator secondary level, venting steam from the steam-generator secondary, venting steam from the hog-leg U-bend, bumping the reactor-coolant pumps, and injecting a portion of the high-pressure-injection system into the hot-leg U-bend aided in cooling and depressurizing the primary system but were ineffective in re-establishing natural-circulation flows in the primary-coolant loops.

556 **(LA-UR—83-2806) TRAC-PF1 post-test predictions for the Semiscale Natural-Circulation Tests S-NC-2 and S-NC-6.** Booker, C.P. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-830901—16). NTIS, PC A02/MF A01. Order Number DE84001031.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

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The TRAC prediction are compared to the data for the Semiscale natural-circular Tests S-NC-2B and S-NC-6. S-NC-2B is a baseline test covering single- and two-phase natural circulation as well as reflux; here TRAC compares quite well with the experiment results for mass flow. For Test S-NC-6, which is a reflux test with various amounts of nitrogen injected into the system, the TRAC prediction of the reflux rate is close to the experiment value with no nitrogen in the system. Ultimately, the maximum reflux rate predicted by TRAC is about 20% higher than the data.

557 **(LA-UR—83-2816) TRAC-PF1: pressurized-thermal shock calculations for several small-break loss-of-coolant accident transients in the Oconee-1 nuclear power plant.** Burkett, M.W.; Bassett, B. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 17p. (CONF-830901—15). NTIS, PC A02/MF A01. Order Number DE84001032.

From Anticipated and abnormal plant transients in light water reactors conference; Jackson, WY, USA (26 Sep 1983).

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This paper presents the thermal-hydraulic response of the Oconee-1 plant to several small-break loss-of-coolant accidents and a description of the TRAC-PF1 plant model of Oconee-1 used in support of the Nuclear Regulatory Commission directed pressurized thermal shock study. The small-break transients investigated included a stuck-open power-operated-relief-valve, a 2-in.-diam surge line break, and a 4-in.-diam surge line break. The results of the TRAC-PF1 calculations indicated that none of the small-break accidents investigated were found to be serious pressurized thermal shock transients.

558 **(NUREG—0090-Vol.6-No.1) Report to Congress on abnormal occurrences, January-March 1983.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Sep 1983. 49p. NTIS, PC A03/MF A01 - GPO. Order Number DE84900184.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from January 1 to March 31, 1983. The report states that for this report period, there were three abnormal occurrences at the nuclear power plants licensed by the NRC to operate. The first involved a main feedwater line break due to water hammer. The second involved management and procedural control deficiencies. The third involved failure of the automatic reactor trip system. There were no abnormal occurrences for the other NRC licensees. There were six abnormal occurrences at Agreement State licensees. One involved an individual who ingested and was contaminated by radioactive material. Four involved lost or stolen radioactive sources. One involved radioactive contamination of a metals production facility.

559 **(NUREG—0828) Integrated plant-safety assessment, Systematic Evaluation Program: Big Rock Point Plant (Docket No. 50-155).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1983. 750p. NTIS, PC A99/MF A01 - GPO $13.00. Order Number DE84900175.

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The Systematic Evaluation Program was initiated in February 1977 by the US Nuclear Regulatory Commission to review the designs of older operating nuclear reactor plants to reconfirm and document their safety. This report documents the review of the Big Rock Point Plant, which is one of ten plants reviewed under Phase II of this program. This report indicates how 137 topics selected for review under Phase I of the program were addressed. It also addresses a majority of the pending licensing actions for Big Rock Point, which include TMI Action Plan requirements and implementation criteria for resolved generic issues. Equipment and procedural changes have been identified as a result of the review.

560 **(NUREG—0985-Vol.1) US Nuclear Regulatory Commission human-factors program plan.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1983. 77p. NTIS, PC A05/MF A01 - GPO $4.50. Order Number DE84900280.

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The purpose of the NRC Human Factors Program Plan is to ensure that proper consideration is given to human factors in the design, operation, and maintenance of nuclear facilities. This initial plan addresses nuclear power plants (NPP) and describes (1) the technical assistance and research activities planned to provide the technical bases for the resolution of the remaining human factors related tasks described in NUREG-0660, The NRC Action Plan Developed as a Result of the TMI-2 Accident, and NUREG-0737, Clarification of TMI Action Plan Requirements, and (2) the additional human factors efforts identified during implementation of the Action Plan that should receive NRC attention. The plan represents a systematic and comprehensive approach for addressing human factors concerns important to NPP safety in the FY-83 through FY-85 time frame.

561 **(NUREG—1007) Safety-evaluation report related to the license renewal and power increase for the National Bureau of Standards Reactor (Docket No. 50-184).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1983. 114p. NTIS, PC A06/MF A01 - GPO $5.00. Order Number DE84900020.

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This Safety Evaluation Report for the application filed by the National Bureau of Standards (NBS) for an increase in power from 10 MWt to 20 MWt and for a renewal of the Operating License TR-5 to continue to operate the test reactor has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Gaithersburg, Maryland, on the site of the National Bureau of Standards, which is a bureau of the Department of Commerce. The staff concludes that the NBS reactor can operate at the 20 MWt power level without endangering the health and safety of the public.

562 **(NUREG—1018) Seismic qualification of equipment in operating plants.** Chang, T.Y. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1983. 85p. NTIS, PC A05/MF A01 - GPO $4.50. Order Number DE84900186.

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The objective of technical studies being performed under the Task Action Plan for Unresolved Safety Issue (USI) A-46 is to establish an explicit set of guidelines and acceptance criteria to judge the adequacy of the seismic qualification of equipment at all operating plants, in lieu of requiring current qualification criteria which are applied to new plants. This report summarizes the status of work accomplished on USI A-46 by the Nuclear Regulatory Commission staff and its contractors. This assessment leads to the conclusion that the use of seismic experienced data for equipment qualification provides the only reasonable alternative to current qualification criteria. Consideration of seismic qualification by use of experienced data was a specific task in USI A-46. Several other A-46 tasks serve to support the use of an experience data base. The status of continuing efforts to establish requirements for an experience data base is provided in this report.

563 **(NUREG/CR—2000-Vol.2-No.8) Licensee Event Report (LER) compilation for month of August 1983.** (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 155p. (ORNL/NSIC—200-Vol.2-No.8). NTIS, PC A08/MF A01 - GPO. Order Number DE84000143.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during August

1983. The LERs are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility.

564 **(NUREG/CR—2300-Vol.1) PRA Procedures Guide: a guide to the performance of probabilistic risk assessments for nuclear power plants. Final report, Volume 1 - Chapters 1-8.** (American Nuclear Society, La Grange Park, IL; Institute of Electrical and Electronics Engineers, Inc., New York (USA)). Jan 1983. 488p. NTIS, PC A21/MF A01 - GPO $11.00. Order Number DE84900179.

This document, the Probabilistic Risk Assessment (PRA) Procedures Guide, is intended to provide an overview of the risk-assessment field as it exists today and to identify acceptable techniques for the systematic assessment of the risk from nuclear power plants. Topics discussed include: organization of PRA; accident-sequence definition and system modeling; human-reliability analysis; data-base development; accident-sequence quantification; physical processes of core-melt accidents; and radionuclide release and transport.

565 **(NUREG/CR—2679-1-Vol.21) Advanced reactor safety research quarterly report, January-March 1982. Vol. 21.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1983. Contract AC04-76DP00789. 348p. (SAND—82-0904-1-Vol.21). NTIS, PC A15/MF A01 - GPO. Order Number DE84001515.

Information is presented concerning core debris behavior (inherent retention); containment analysis; elevated temperature design assessment; Clinch River risk assessment study; advanced reactor core phenomenology; LWR damaged fuel relocation phenomenology; and Annular Core Research Reactor facilities and operation.

566 **(NUREG/CR—2986) Use of performance shaping factors and quantified expert judgment in the evaluation of human reliability: an initial appraisal.** Embrey, D.E. (Brookhaven National Lab., Upton, NY (USA)). May 1983. Contract AC02-76CH00016. 77p. (BNL-NUREG—51591). NTIS, PC A05/MF A01 - GPO. Order Number DE84001441.

The first part of the report considers the nature of human reliability assessment, and the techniques currently employed. It is concluded that most approaches are limited by the availability of data. Approaches to the subjective assessment of error are surveyed. A particular technique which has been developed, the Success Likelihood Index Methodology (SLIM), is described in detail, together with the practical steps for its implementation. The results from a trial application of a questionnaire designed to elicit judges' perceptions of the relative importance of performance shaping factors in determining human reliability are analyzed. A revised form of the questionnaire is presented for future use. A pilot experiment to investigate the relationship between subjectively derived indices of success for six tasks and their objective probability of success is described. The results indicate that the SLIM has potential value as a predictive technique. Some requirements for a program of research to produce a generally applicable methodology are set out.

567 **(NUREG/CR—3043) Development of the inductive ring susceptor technique for sustaining oxide melts.** Copus, E.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1983. Contract AC04-76DP00789. 60p. (SAND—82-2546). NTIS, PC A04/MF A01 - GPO. Order Number DE84001520.

A method for melting and sustaining large volumes of UO_2 has been developed at Sandia. This capability will greatly enhance reactor safety studies in the areas of ex-vessel interactions and degraded core retention by providing out-of-pile simulation for the decay heat process that is inherent to reactor core debris. The method, referred to as the Inductive Ring Susceptor Technique, melts UO_2 powder via inductively heated susceptor rings fashioned from highly conductive refractory metal. These rings are embedded in the non-conductive charge material. Placement of the rings is designed for optimum heat transfer and a controlled pool-type geometry. The technique has been demonstrated by a series of sustained oxide melt experiments.

568 **(NUREG/CR—3051) Closeout of IE Bulletin 80-05: vacuum condition resulting in damage to low-pressure tanks which may contain primary-system water.** Foley, W.J.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Oct 1983. 50p. NTIS, PC A03/MF A01 - GPO $4.25. Order Number DE84900019.

In early 1977, low pressure tanks at the Trojan and Rancho Seco Nuclear Stations buckled because of accidental conditions resulting from a partial vacuum. Both of these damaged tanks released radioactive gases. IE Circular 77-10 was issued on July 15, 1977 to caution PWR facility personnel about providing adequate protection for low pressure tanks which may contain primary system water. However, because similar tank failures occurred later at Turkey Point 3 and Salem 1, despite issuing the Circular, Bulletin 80-05 was issued on March 10, 1980 to require further action by utilities. Utility responses and IE inspection reports are evaluated on the basis of closeout criteria, for 49 facilities with operating licenses and 39 facilities with construction permits. Followup items are proposed for 30 of these 88 current PWR facilities. Therefore, the Bulletin has been closed out for 66% of the current facilities. A search conducted by the Nuclear Safety Information Center at the Oak Ridge National Laboratory indicates that none of these tanks has failed since the issuance of IE Bulletin 80-05 on March 10, 1980, and provides assurance that the Bulletin has been effective.

569 **(NUREG/CR—3192) Investigation of twenty-foot separation distance as a fire-protection method as specified in 10 CFR 50, Appendix R.** Cline, D.D.; von Riesemann, W.A.; Chavez, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 131p. (SAND—83-0306). NTIS, PC A07/MF A01 - GPO. Order Number DE84001514.

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A combined experimental/analytical program was conducted to examine the adequacy of the 20-foot separation requirement, one of the requirements set forth in Appendix R of 10 CFR 50 for the fire protection of redundant safety systems that are necessary to achieve hot shutdown in nuclear power plants. Specifically, Sections III.G.2.b and d of Appendix R require separation of the redundant safety systems by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. Section III.G.2.b also requires installation of fire detectors and an automatic fire suppression system within fire areas. The experimental investigation consisted of six full-scale fire tests of unqualified and qualified electrical cables separated by 20 feet with (1) no protection, (2) protection with a ceramic fiber blanket and sheet metal covers on the cable trays, and (3) protection with a fire protective coating. For the test conditions investigated, all unqualified cable electrically shorted while qualified cable was found to short only when left unprotected.

570 **(NUREG/CR—3198) D7 debris-bed experiment.** Mitchell, G.W.; Ottinger, C.A.; Lipinski, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1983. Contract AC04-76DP00789. 56p. (SAND—82-0062). NTIS, PC A04/MF A01 - GPO. Order Number DE84000918.

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The D7 experiment investigated heat removal from a shallow, stratified bed of UO_2 particulate in sodium. The particle diameters ranged from 0.1 to 1.0 mm, with the largest particles at the bottom. The bed thickness was 74 mm and the average porosity was 41%. The incipient dryout power varied from 0.43 W/g to 0.25 W/g as the sodium subcooling (saturation temperature minus overlying pool temperature) was reduced from 390°C to 170°C. These powers were only slighlty above the incipient boiling powers. Such low dryout powers are believed due to the interaction of capillary force with bed stratification. With a subccoling of 130°C several sudden decreases in the saturation temperature occurred. These are believed due to channel formation, which causes a reduction in the capillary pressure in the bed.

571 **(NUREG/CR—3288) Intermediate-scale tests of sodium interactions with calcite and dolomite aggregate concretes.** Randich, E.; Acton, R.U. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1983. Contract AC04-76DP00789. 105p. (SAND—83-1064). NTIS, PC A06/MF A01 - GPO. Order Number DE84001154.

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Two intermediate-scale tests were performed to compare the behavior of calcite and dolomite aggregate concretes when attacked by molten sodium. The tests were performed as part of an interlaboratory comparison between Sandia National Laboratories and Hanford Engineering Development Laboratories. Results of the tests at Sandia National Laboratories are reported here. The results show that both concretes exhibit similar exothermic reactions with molten sodium. The large difference in reaction vigor suggested by thermodynamic considerations of CO_2 release from calcite and dolomite was not realized. Penetration rates of 1.4 to 1.7 mm/min were observed for short periods of time with reaction zone temperatures in excess of 800°C during the energetic attack. The penetration was not uniform over the entire sodium-concrete contact area. Rapid attack may be localized due to inhomogeneities in the concrete. The chemical reaction zone is less then one cm thick for the calcite concrete but is about seven cm thick for the dolomite concrete.

572 **(NUREG/CR—3299) Core-melt materials interactions evaluations. Final report, April 1980-April 1983.** Swanson, D.G.; Castle, J.N.; Anderson, P.D.; Catton, I. (Applied Science Associates, Inc., Palos Verdes Peninsula, CA (USA); California Univ., Los Angeles (USA)). Sep 1983. 291p. NTIS, PC A13/MF A01 - GPO $7.50. Order Number DE84900041.

This final report describes work performed on a variety of topics related to the materials interactions that would occur following a postulated core-meltdown accident in a Light Water Reactor. The main topics addressed include: (1) an evaluation of candidate core-retention-system materials for the Zion and Indian Point (Z/IP) nuclear reactors; (2) an examination of various core-retention-system concepts with emphasis on the restrictions imposed by the conditions present in the Z/IP reactors; (3) development of a concept for retrofitting the Z/IP reactors with a molten-core retention device; (4) reactor-cavity conditions following vessel failure, including the existence of a hydraulic jump and molten-core entrainment and sweepout; (5) core debris-concrete crust development, and including the effects of composition, strength, gas pressure and surface tension; (6) a discussion of reactor-containment-system materials in the context of interactions with core debris; (7) reactions forming combustible hydrogen, carbon monoxide, and hydrocarbons; (8) a discussion of the properties and behavior of urania and the prospects for decontamination of aerosols in a BWR suppression pool; and (9) the effect of water salinity and acidity on concrete.

573 **(NUREG/CR—3340) In situ and laboratory benchmarking of computed codes used for dynamic-response predictions of nuclear-reactor piping.** Bezler, P.; Subudhi, M.; Shteyngart, S. (Brookhaven National Lab., Upton, NY (USA)). May 1983. Contract AC02-76CH00016. 73p. (BNL-NUREG—51680). NTIS, PC A04/MF A01 - GPO. Order Number DE84001092.

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The ongoing program to develop analytical piping benchmark solutions for the verification of piping analysis methods has been extended to the consideration and use of physical test results. This report provides a description of the first endeavors in this effort. Specifically the results of benchmark evaluations for a laboratory tested piping system undergoing forced seismic excitation and an in situ tested power plant piping run executing free vibrations are described. The correlations of results for the laboratory tested piping was judged to be good with some exceptions. The correlation for the in situ tests were judged to be poor. Comparisons between predicted and test measured results are provided. The performance of this effort depended on the cooperation of the Electric Power Research Institute (EPRI) and their contractor ANCO Engineers, Inc. which provided all experimental data.

574 **(NUREG/CR—3384) VISA: a computer code for predicting the probability of reactor pressure-vessel failure.** Stevens, D.L.; Simonen, F.A.; Strosnider, J. Jr.; Klecker, R.W.; Engel, D.W.; Johnson, K.I. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 89p. (PNL—4774). NTIS, PC A05/MF A01 - GPO $4.50. Order Number DE84001153.

The VISA (Vessel Integrity Simulation Analysis) code was developed as part of the NRC staff evaluation of pressurized thermal shock. VISA uses Monte Carlo simulation to evaluate the failure probability of a pressurized water reactor (PWR) pressure vessel subjected to a pressure and thermal transient specified by the user. Linear elastic fracture mechanics are used to model crack initiation and propagation. parameters for initial crack size, copper content, initial RT/sub NDT/, fluence, crack-initiation fracture toughness, and arrest fracture toughness are treated as random variables. This report documents the version of VISA used in the NRC staff report (Policy Issue from J.W. Dircks to NRC Commissioners, Enclosure A: NRC Staff Evaluation of Pressurized Thermal Shock, November 1982, SECY-82-465) and includes a user's guide for the code.

575 **(NUREG/CR—3406) RELAP5 assessment: LOFT intermediate breaks L5-1 and L8-2.** Orman, J.L.; Kmetyk, L.N. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1983. Contract AC04-76DP00789. 110p. (SAND—83-1575). NTIS, PC E05/MF A01 - GPO. Order Number DE84001513.

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The RELAP5 independent assessment project at Sandia National Laboratories is part of an overall effort funded by the NRC to determine the ability of various systems codes to predict the detailed thermal/hydraulic response of LWRs during accident and off-normal conditions. The RELAP5 code is being assessed at SNLA against test data from various integral and separate effects test facilities. As part of this assessment matrix, an intermediate break transient (L5-1) and a core uncovery transient (L8-2) performed at the LOFT facility have been analyzed. Transient calculations were done with both cycle 14 and cycle 18 of RELAP5/MOD1 and a comparison of the predictions was made. The results show that RELAP5/MOD1 did very well calculating the overall behavior for these intermediate break experiments, although there were a few quantitative disagreements.

576 **(OEFZS—4217) Computer studies on the influence of some scaling distortions on the results of an intermediate break in LOFT.** Sonneck, G.; Pfau, H.; Koinig, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). May 1983. 63p. (RS—219/83). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83703742.

A RELAP 4/MOD 6 study was made based on the blowdown phase of the intermediate break experiment LOFT L5-1. The method was to set up a base model and to vary parametrically some areas where it is known or suspected that LOFT differs from a commercial PWR. The aim was not to simulate LOFT or a PWR exactly but to understand the influence of the following parameters on the thermohydraulic behaviour of the system and the clad temperature: - stored heat in the downcomer (LOFT has rather large filler blocks in this part of the pressure vessel) - bypass between downcomer and upper plenum - core length. The results show that LOFT is prototypical for all calculated blowdowns. As the clad temperatures decrease with decreasing stored energy in the downcomer, increased bypass and increased core length, LOFT results seem to be realistic as long as realistic bypass sizes are considered; they are conservative in the two other areas.

577 **(ORNL/TM—8730) Estimated amount of ^{85}Kr available for release from intact fuel rods in the Three Mile Island Unit 2 Nuclear Power Station.** Lorenz, R.A. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01. Order Number DE84001140.

Reactor core dismantling operations planned for the Three Mile Island Unit 2 Power Station could cause rupture of any fuel

rods that might have survived the accident in a leak-tight condition. Calculations were performed in an attempt to determine the amount of ^{85}Kr that might be present in the free gaseous form in the plenum and void spaces of such fuel rods. Estimates were made of the number of fuel rods surviving intect, the temperature transient to which they were exposed, the amount of ^{85}Kr orginally produced in the fuel in these rods, and the amounts released from the UO_2 matrix to the plenums both before the accident and during the accident (as a result of heatup). Since there is considerable uncertainty in these quantities, particularly the number of surviving fuel rods and the temperature transient they experienced, an analysis was made of the importance of these assumptions. Results of the analysis show that ~30 Ci of ^{85}Kr could exist in the free state in the plenums of intact rods; however, this quantity might range anywhere from 0 to 100 Ci. 8 figures, 6 tables.

578 **(PNL—4902) Decontamination analysis of the NUWAX-83 accident site using DECON.** Tawil, J.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1983. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01. Order Number DE84001169.

This report presents an analysis of the site restoration options for the NUWAX-83 site, at which an exercise was conducted involving a simulated nuclear weapons accident. This analysis was performed using a computer program deveoped by Pacific Northwest Laboratory. The computer program, called DECON, was designed to assist personnel engaged in the planning of decontamination activities. The many features of DECON that are used in this report demonstrate its potential usefulness as a site restoration planning tool. Strategies that are analyzed with DECON include: (1) employing a Quick-Vac option, under which selected surfaces are vacuumed before they can be rained on; (2) protecting surfaces against precipitation; (3) prohibiting specific operations on selected surfaces; (4) requiring specific methods to be used on selected surfaces; (5) evaluating the trade-off between cleanup standards and decontamination costs; and (6) varying of the cleanup standards according to expected exposure to surface.

579 **(SAND—83-1965C) Performance and effects of terminal blocks in a loss-of-coolant accident environment.** Craft, C.M. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 23p. (CONF-831043—5). NTIS, PC A02/MF A01. Order Number DE84001642.

From Seminar on transport of radioactive material by post; Vienna, Austria (24 Oct 1983).

Terminal blocks continue to be used in instrumentation and control (I and C) applications in the nuclear-power industry. However, for many terminal blocks the qualification tests use an acceptance criterion which does not quantify the performance of terminal blocks at the low voltage and current levels of I and C applications. Our tests monitored terminal block performance during LOCA steam and chemical spray simulations and were conducted at current and voltage levels representative of I and C applications. Leakage currents from 0.5 mA to 15 mA were observed. These values are of sufficient magnitude to affect some I and C applications.

580 **American National Standard: nuclear-safety criteria for the design of stationary pressurized-water-reactor plants.** La Grange Park, IL; American Nuclear Society (1983). 101p. (ANSI/ANS—51.1-1983). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $45.00.

This standard establishes the nuclear safety criteria and functional design requirements of structures, systems, and components of stationary pressurized water reactor (PWR) power plants. Operations, maintenance, and testing requirements are covered only to the extent that they affect design provisions. A methodology is given for classifying all equipment into one of three Safety Classes according to its importance to nuclear safety or into a Non-Nuclear Safety Class. Another methodology is given for identifying and categorizing into one of five Plant Conditions the normal operations and events for which the plant shall be designed. Acceptance criteria are given for each Plant Condition. Specific design requirements are given for each major system in a typical plant.

581 **Analysis of loss-of-flow transients in a pool-type LMFBR using SSC-P.** Madni, I.K. (University of Petroleum and Minerals, Drahran (Saudi Arabia)); Cazzoli, E.G. (Brookhaven National Laboratory Upton, N.Y. (USA)). pp 57-66 of Actes de la conference de Lyon. Vol. 2 (Proceedings of the LMFBR safety topical meeting. Vol. 2). Paris, France; SFEN (1982). (CONF-820704—).

From International topical meeting on LMFBR safety; Lyon, France (18 Jul 1982).

In order to have a general analytical capability for the safety evaluation of any proposed LMFBR system, the USNRC is sponsoring the development and validation of computer codes for both pool- and loop-type plants. The computer code for pool-type LMFBRs is designated SSC-P. This paper is concerned with the application of SSC-P to simulate loss-of-flow accident transients in a pool-type LMFBR. The models required for dynamic plant simulation are briefly highlighted. The system response is calculated for a complete loss of electric power event, with scram leading the plant into buoyancy-induced natural circulation, a protected pipe rupture accident in the primary pump discharge line, and an unprotected loss of off-site power event. For the last case, the predicted results from SSC-P are compared with the published results of Phenix behavior by NOVATOME.

582 **PFR/TREAT CO1 and LO1 experiments.** Tylka, J.P.; Wright, A.E. (Argonne National Laboratory, IL (USA)); Pember, L.A.; Culley, G.C. (Westinghouse Hanford Co., Richland, WA (USA)); Davies, A.L.; Herbert, R.; Hill, D.J.; Woods, W.J. (UKAEA, AEE Winfrith (UK)); Wood, M.H. (UKAEA, AERE Harwell (UK)). pp 439-448 of Actes de la conference de Lyon. Vol. 4 (Proceedings of the LMFBR safety topical meeting. Vol. 4). Paris, France; SFEN (1982). (CONF-820704—).

From International topical meeting on LMFBR safety; Lyon, France (18 Jul 1982).

The CO1 and LO1 TREAT experiments were the first two in a series of international fast reactor safety experiments to be conducted as part of the PFR/TREAT program being performed by the US and the UK. Conditions for these two experiments simulated a large fast reactor hypothetical (150 ms period) transient overpower (TOP) accident. The CO1 configuration was a single fuel pin in a NaK filled capsule while LO1 used a seven-pin bundle in a flowing sodium loop. The fuel pins in both experiments had no prior irradiation and represented the PFR driver fuel. The CO1 and LO1 experiments were performed on November 5 and November 24, 1980, respectively. This paper describes the objectives, test articles, experimental approach, and the major observations. Post-transient examination results and fuel failure modeling studies are also presented.

583 **American National Standard: application criteria for programmable digital computer systems in safety systems of nuclear power generating stations.** La Grange Park, IL; American Nuclear Society (1982). 14p. (ANSI/IEEE-ANS—7-4.3.2-1982). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $7.50.

This standard establishes application criteria for programmable digital computer systems used in safety systems for nuclear power generating stations by expanding the quality and equipment qualification requirements of IEEE Std 603-1980, Standard Criteria for Safety Systems for Nuclear Power Generating Stations, to encompass software design, software implementation, and computer system validation. The interrelationships among the various processes in the application of programmable digital computer systems in safety systems for nuclear power generating stations are illustrated. This standard does not consider site installation, site testing, or maintenance of the computer system.

584 **American National Standard: for emergency planning for research reactors.** La Grange Park, IL; American Nuclear Society (1982). 13p. (ANSI/ANS—15.16-1982). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $16.00.

This standard identifies the elements of an emergency plan which describes the approach to coping with emergencies and mini-

mizing the consequences of accidents at research reactor facilities. The emphasis given each of these elements shall be commensurate with the potential risk involved. The emergency plan shall be implemented by emergency procedures.

585 **Methods for developing seismic and extreme wind hazard models for evaluating critical structures and equipment at U.S. Department of Energy facilities and commercial plutonium facilities in the United States.** Coats, D.W.; Murray, R.C.; Bernreuter, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp K1/7 of Structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Amsterdam, Netherlands; North-Holland Publ. Co. (1981). (CONF-810801—Vol.K(a)). Contract W-7405-ENG-48.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

With 3 figs.

Lawrence Livermore National Laboratory (LLNL) is developing seismic and wind hazard models for the U.S. Department of Energy (DOE). The work is part of a three-phase effort to establish building design criteria developed with a uniform methodology for seismic and wind hazards at the various DOE sites throughout the United States. In Phase 1, LLNL gathered information on the sites and their critical facilities, including nuclear reactors, fuel-reprocessing plants, high-level waste storage and treatment facilities, and special nuclear material facilities. Phase 2--development of seismic and wind hazard models--is discussed in this paper, which summarizes the methodologies used by seismic and extreme-wind experts and gives sample hazard curves for the first sites to be modeled. These hazard models express the annual probability that the site will experience an earthquake (or windspeed) greater than some specified magnitude. In the final phase, the DOE will use the hazards models and LLNL-recommended uniform design criteria to evaluate critical facilities.

586 **Seismic risk analysis by uniform and variable seismicity approaches.** Ahmed, H.U.; Malek, R.A. (Argonne National Lab., IL (USA)). pp K1/8 of Structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Amsterdam, Netherlands; North-Holland Publ. Co. (1981). (CONF-810801—Vol.K(a)).

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

With 3 figs. and 6 tabs.

Argonne National Laboratory is located in Illinois approximately 250 miles from the New Madrid Fault Zone (Missouri). The site is located 120 ft. above the rock base, and the soil is composed of several layers of clay and sand. At this site several experimental reactors are located, including the ZPR-6 reactor facility. A seismic risk analysis of the Argonne National Laboratory site has been performed using both uniform and variable seismicity approaches. The uniform seismicity assumption was initially described by Housner. The approach is normally applied to sites in regions where the historic earthquakes of greatest magnitude can not be related to known tectonic structures but can be identified with tectonic province. The mathematical procedure described in this paper can be used when two important probabilistic assumptions are reasonably satisfied. These assumptions are: (1) there is an equal likelihood that a given seismic event can occur anywhere in the region, and; (2) the arrival rates of earthquake events are independent and can be modeled as a Poisson distribution.

587 **Event specific seismic hazard analysis.** Mortgat, C.P. (Tera Corp., Berkeley, CA (USA)); Bernreuter, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp K1/11 of Structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Amsterdam, Netherlands; North-Holland Publ. Co. (1981). (CONF-810801—Vol.K(a)).

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

With 3 figs. and 2 tabs.

Seismic hazard analyses commonly express the exposure at a site in terms of uniform hazard spectra (UHS). They are defined as 'spectra of which each ordinate has the same probability of being exceeded in a fixed period of time.' All events capable of effecting the site are considered in assessing the probability of exceedance. From such definition it results that no single earthquake has a spectrum corresponding to the UHS since different types of earthquakes contribute to different frequency bands of the spectrum. Such approach introduces conservatism in design, particularly in the generation of artificial time histories as their frequency content is much broader than the one of real earthquakes. In the context of the Seismic Safety Margin Research Program (SSMRP) funded by the Nuclear Regulatory Commission (NRC), this research attempts to circumvent the problem by expressing the seismic hazard at a site located in the central United States in terms of event specific response spectra corresponding to the particular types of earthquakes the site is expected to be subjected to. The procedure is based on simulation to retain the individual character of earthquakes. The parameters describing the simulation of one event at the site are (1) the PGA in both horizontal directions associated with the same spectral shape, (2) the PGA and spectral shape in the vertical direction and (3) the duration. This information is sufficient to either select real time histories or generate artificial ones to compute nonlinear structural response. The methodology appears promising in less research oriented applications as the additional effort over standard approaches is small compared to the additional amount of information it provides.

588 **Evaluation of the seismic integrity of a plutonium handling facility.** Coats, D.W. (Lawrence Livermore National Lab., CA (USA)). pp K8/10 of Structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Amsterdam, Netherlands; North-Holland Publ. Co. (1981). (CONF-810801—Vol.K(a)).

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

With 1 fig.

Many studies have been made by and for the Lawrence Livermore National Laboratory (LLNL) to ensure the seismic safety of its Plutonium Facility (Building 332). These studies have included seismological and geologic field investigations to define the actual seismic hazard existing at the Laboratory site as well as structural studies of the Facility itself. Because the basic seismic design criteria has undergone changes over the years, numerous structural studies and upgrades have been completed. The seismic criteria in use at the LLNL site is reviewed on a continuing basis as new information on the seismicity and geology of the Livermore Valley is obtained. At present, the Laboratory's Earth Sciences Division is conducting a multi-million dollar program to identify and characterize the geologic hazards at the Livermore site, with the primary emphasis on earthquake hazards in the Livermore Valley. This effort is undergoing an independent review by Woodward-Clyde Associates. Additionally, because of increased concerns over the seismic safety of Building 332, the Laboratory has initiated an independent structural review. This review effort will be monitored by the California Seismic Safety Commission to ensure its independence. Both of these studies are in their early stages and results are not yet available.

589 **American National Standard: fire-protection program criteria for research reactors.** La Grange Park, IL; American Nuclear Society (1981). 13p. (ANSI/ANS—15.17-1981). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $15.00.

This standard provides criteria for a fire protection program for research reactor facilities and for the reactor safety-related systems included in those facilities. It stresses preservation of the capability to achieve and maintain safe shutdown of the reactor, and includes consideration of both direct fire hazards and indirect or consequential hazards.

590 **American National Standard: for facilities and medical care for on-site nuclear-power-plant radiological emergencies.** La Grange Park, IL; American Nuclear Society (1979). 13p. (ANSI/ANS—3.7.1-1979). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $16.00.

This standard provides guidance for first aid during an emergency and for initial medical care of those persons on-site who are overexposed to penetrating radiation (irradiated). It also provides guidance for medical care of persons contaminated with radioactive material or radionuclides who may also be irradiated or injured as a result of an accident at a nuclear power plant. It provides recommendations for facilities, supplies, equipment, and the extent of care both on-site where first aid and initial care may be provided and off-site at a local hospital where further medical and surgical care may be provided. This initial care continues until either the patient is released or admitted, or referred to another, possibly distant, medical center for definitive care. Recommendations are also provided for the transportation of patients and the training of personnel. Recommendations for specialized care are considered to be beyond the scope of this standard on emergency medical care; however, since emergency and specialized care are related, a brief discussion of specialized care is provided in the Appendix.

591 **American National Standard: LMFBR safety classification and related requirements.** La Grange Park, IL; American Nuclear Society (1979). 31p. (ANS—54.6-DRAFT). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $17.00.

This standard provides requirements for the safety classification of LMFBR plant structures, systems, components or parts thereof, in the context of design base events, and identifies corresponding design and quality requirements based on the General Safety Design Criteria for an LMFBR Nuclear Power Plant, ANSI N214. Guidance for LMFBR plants analogous to that provided in Regulatory Guides and ANSI Standards N18.2 (PWR) and N212 (BWR) for water reactor plants is included.

592 **American National Standard: criteria for the reactor-safety systems of research reactors.** La Grange Park, IL; American Nuclear Society (1978). 17p. (ANSI/ANS—15.15-1978). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $17.00.

This standard documents the criteria from which appropriate specific design requirements may be established for the reactor safety system of an individual research reactor.

593 **American National Standard: earthquake instrumentation criteria for nuclear power plants.** La Grange Park, IL; American Nuclear Society (1978). 17p. (ANSI/ANS—2.2-1978). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $20.00.

This standard is intended for use at light water-cooled, land-based nuclear power plants and may be used for guidance, where appropriate, at other types of nuclear power plants. Earthquake instrumentation is specified for the site, structures, equipment and piping. The kind and number of instruments required depend on the safe shutdown earthquake maximum ground acceleration designated for the plant. This standard does not include the following: (a) Instrumentation to automatically shut down a nuclear power plant at a predetermined ground acceleration. (b) Instrumentation to specifically provide information which would increase knowledge and understanding of seismic design. The need for such instrumentation is the basis for ongoing research and development programs. (c) Methods of analysis of recorded data.

25 ENERGY STORAGE

2501 Magnetic

594 **(LA-UR—83-2594) Design and operation of the 30-MJ superconducting magnetic-storage system on the Bonneville Power Administration bus.** Schermer, R.I.; Barron, M.H.; Boenig, H.J.; Brown, R.R.; Criscuolo, A.L.; Cumming, C.J.; Dean, J.W.; Hassenzahl, W.V.; Rogers, J.D.; Seamons, M.J. (Los Alamos National Lab., NM (USA); Bonneville Power Administration, Portland, OR (USA); GA Technologies, Inc., San Diego, CA (USA)). 1983. Contract W-7405-ENG-36. 11p. (CONF-830841—26). NTIS, PC A02/MF A01. Order Number DE84000487.

From Cryogenic engineering conference and international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

A superconducting magnetic-energy-storage (SMES) unit is suitable for power-system stabilization because it can provide positive damping by absorbing or releasing energy with a relatively fast response time, 10 ms. In the fall of 1982, an SMES unit was installed at the Tacoma Substation of the Bonneville Power Administration as an experiment in monitoring, predicting and improving system stability. This paper reports principally on the system testing.

595 **(NRL-MR—5205) Theoretical modeling of the plasma-erosion opening switch for inductive-storage applications.** Ottinger, P.F.; Goldstein, S.A.; Meger, R.A. (Naval Research Lab., Washington, DC (USA)). 27 Oct 1983. Contract AI08-79DP40092. 45p. NTIS, PC A03/MF A01. Order Number DE84001843.

A theoretical model for the plasma erosion opening switch (PEOS) is presented which predicts its voltage, current and impedance history as a function of the input waveforms, geometry and switch parameters. Scaling laws for the switch operation are developed from this model. Systems requirements for pulse compression and power multiplication using inductive storage are derived from a simple lumped circuit analysis and a transmission line analysis. These requirements are shown to be satisfied using the PEOS as a fast opening, vacuum switch in a configuration relevant for existing high power accelerators. The switch model is incorporated into a transmission line code for comparison with recent inductive storage experiments. Code results agree well with the data and show conduction times of $\sim$ 60 ns, switching times of $\sim$ 10 ns with peak currents of $\sim$ 600 kA.

2502 Compressed Gas

596 **(PNL—4623) Physical modeling of the champagne effect.** Thompson, P.A.; Sneck, H.J.; Hand, B.; Meyer, B.; Ping, C.; Roehl, E. (Pacific Northwest Lab., Richland, WA (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). Sep 1983. Contract AC06-76RL01830. 97p. NTIS, PC A05/MF A01. Order Number DE84001813.

Successful commercialization of compressed air energy storage (CAES) technology depends largely on the ability to understand and predict potentially detrimental aspects of its implementation. A particularly important concern is the champagne effect, a hydraulic process with the potential to cause a loss of storage cavern pressure or even blowout of the cavern. Under subcontract to the Pacific Northwest Laboratory, researchers at Rensselaer Polytechnic Institute conducted an investigation to determine the factors that influence bubble formation in a CAES cavern. Using this information, they then undertook to develop a model to predict the effect of those bubbles on the discharge of water from a CAES cavern. This research project involved parallel analytical and experimental efforts. Two physical models were developed, one relatively simple and analytical, the other much more detailed and numerical. A high-solubility carbon dioxide/water laboratory model of a CAES system was also constructed. Results obtained from bubble formation experiments using the laboratory-scale CAES facility were compared with those generated by the predictive models. The high-solubility CO_2/H_2O champagne effect laboratory model successfully simulated the behavior of a CAES system. Researchers noted that varying conditions and heterogeneous nucleation in bulk produced profound differences in the vigor of the observed champagne effect. Experimental observations further suggest that reproducible heterogeneous nucleation experiments are possible. The simple analytical model was found to show excellent agreement with the detailed numerical model. The latter, in turn, showed good agreement with the data obtained experimentally in the laboratory-scale CAES facility. Researchers concluded that physical modeling is relevant to practical studies of the champagne effect, and that the results of such modeling should be used in designing future experiments.

2506 Thermal

597 (DOE/R4/10105—T1) Cooling and dehumidification by nocturnal radiation. Final report. Scarborough, S.M.; Lupton, C.E. Jr. (Scarborough (Sidney M.), Biloxi, MS (USA)). Jul 1981. Contract FG44-80R410105. 21p. NTIS, PC A02/MF A01. Order Number DE84000264.

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An experimental apparatus whose major parts were a radiator and a rock bin storage was constructed and data were taken to investigate cooling and dehumidification by means of nocturnal radiation. The temperature of the rock bin storage could not be brought down to the minimum ambient night time temperature. The radiator was able to collect some water during the night. No water drained from the rock bin as air passed through it during day. While the results were not as good as expected, there appears to be some summer time benefits available from such a system in some regions.

598 (PNL—4849) Design, performance, and analysis of an aquifer thermal-energy-storage experiment using the doublet-well configuration. Molz, F.J.; Melville, J.G.; Gueven, O.; Parr, A.D. (Auburn Univ., AL (USA). Dept. of Civil Engineering). Sep 1983. Contract AC06-76RL01830. 121p. NTIS, PC A06/MF A01. Order Number DE84001811.

In March 1980 Auburn University began series of aquifer thermal energy storage (ATES) experiments using the doublet well configuration. The test site was in Mobile, Alabama. The objectives of the three experimental cycles were to demonstrate the technical feasibility of the ATES concept, to identify and resolve operational problems, and to acquire a data base for developing and testing mathematical models. Pre-injection tests were performed and analyses of hydraulic, geochemical, and thermodynamic data were completed. Three injection-storage-recovery cycles had injection volumes of 25,402 m^3, 58,010 m^3, and 58,680 m^3 and average injection temperatures of 58.5°C, 81.0°C, and 79.0°C, respectively. The first cycle injection began in February 1981 and the third cycle recovery was completed in November 1982. Attributable to the doublet well configuration no clogging of injection wells occurred. Energy recovery percentages based on recovery volumes equal to the injection volumes were 56, 45, and 42%. Thermal convection effects were observed. Aquifer nonhomogeneity, not detectable using standard aquifer testing procedures, was shown to reduce recovery efficiency.

2508 Chemical

REFER ALSO TO CITATION(S) 955

2509 Batteries

REFER ALSO TO CITATION(S) 787

599 (ANL/OEPM—83-6) Research, development, and demonstration of advanced lead-acid batteries for utility load leveling. Final report. (Exide Management and Technology Co., Yardley, PA (USA)). Aug 1983. Contract W-31-109-ENG-38. 246p. NTIS, PC A11/MF A01. Order Number DE84002683.

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An advanced lead-acid storage battery has been developed to the preprototype cell and module design stage. Accelerated tests on full-size plates in 3, 5, and 17-plate cell sizes predict a cycle life goal of 4000 cycles at 80% depth-of-discharge can be achieved at 25°C on a 2 cycle per day regime. One 6-cell 36 kwh and two 3-cell 18 kwh modules of cells in series were assembled and delivered to the ANL/NBTL for utility application and accelerated cycling tests. Each module is equipped with a low cost tray, automatic watering system, and air-lift pumps for increased acid circulation in each cell. Positive grid corrosion was measured in 5-plate cells at 50 to 55°C during 166 kAh continuous overcharge to qualify a grid alloy. Up to 60% weight loss was observed on one test alloy. With the qualified alloy catastrophic positive grid corrosion will not limit cell cycle life. An accelerated shallow cycle regime at room ambient tested 60 cell designs for the active material shedding failure mode. An anti-shedding active material additive was found to reduce positive active material shedding significantly and extend the cycle life of both the positive and the negative plate. An accelerated 2-deep cycle per day test regime at 70°C with 80% DoD and 24% overcharge selected 10 of 60 cell designs with a predicted cycle life greater than 5000 equivalent 25°C cycles. Equations relating cell design to deep cycle life were developed from the factorial tests on the 60 cells. Eight 35-plate preprototype cells are cycling at EXIDE to prove the room ambient cycle life predicted by the accelerated test at 70°C. Cell, module and battery prices are projected, based on the 6 kwh preprototype cell design.

600 (DOE/NASA/12726—23) NASA redox storage system development project. Calendar year 1982. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1983. Contract AI04-80AL12726. 28p. (NASA-TM—83469). NTIS, PC A03/MF A01. Order Number DE84002196.

Development was continued for iron-chromium battery operation at 65°C. Membranes that were adequate at 25°C were shown to be unacceptable at 65°C with regard to selectivity. This led to the elevated-temperature, mixed-reactant mode of operation, in which each reactant solution, when discharged, contains both ferrous and chromic chlorides. This operating mode allows the use of very low-resistivity membranes, resulting in high energy efficiencies at current densities. It also allows the use of very simple techniques to correct for solvent or reactant transfer through cell membranes. Screening of candidate catalysts for the chromium electrode led to the development of a bismuth-lead candidate having several attractive characteristics.

601 (LBL—16422) Effects of small flow obstacles on the limiting current and pressure drop in a square duct. Fischl, D.S.; Muller, R.H.; Tobias, C.W. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 199p. NTIS, PC A09/MF A01. Order Number DE84001880.

Thesis.

The effectiveness of mass transfer enhancement by small obstacles attached to the cathode in a 0.5 by 0.5 cm square cross section 50.8 cm long electrochemical flow cell was investigated. Pressure drops, and limiting currents for the reduction of ferricyanide were measured in the range of $80 \leq Re \leq 3200$. Using rectangular obstacles extending 0.0254 to 0.160 cm from the surface, the spacing to height ratio ranged from 9 to 170. Flow patterns around obstacles were visualized using suspensions of inert materials and recorded by means of dark field photography. Depending on the flow rate, addition of the obstacles can increase mass transfer rates by as much as five times over those in the unobstructed system. The degree of enhancement increases with decreasing obstacle spacing until an optimal spacing is reached. At $Re \approx 100$, the mass transfer rate is approximately doubled upon addition of the optimal number of obstacles without appreciably affecting the pressure drop. The largest enhancement (5-fold) occurs at the upper laminar flow regime with a 2.7-fold increase in the pressure drop. These comparisons are made at the same flow rate. In the unobstructed system, improved mass transfer rates (limiting currents) are achieved by increasing the flow rate to produce turbulent flow. This approach involves large pressure drops and consequently large pumping power requirements. An increase in the limiting current by the addition of obstacles, on the other hand, requires only a very small fraction (2 to 5 percent) of the pumping power required to obtain the same limiting current achieved by increasing the flow rate in the unobstructed system. Obstacles therefore produce efficient mixing near the electrode surface and correspondingly high mass transfer rates without causing large energy dissipation in the bulk fluid.

602 (LBL—16485) Effect of hydrodynamic flow on the morphology of electrodeposited zinc. Faltemier, J.L.; Tobias, C.W. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 169p. NTIS, PC A08/MF A01. Order Number DE84001816.

Portions are illegible in microfiche products; Thesis. Submitted by J.L. Faltemier.

The influence of hydrodynamic flow and other process variables on the macromorphology of electrodeposited zinc have been investigated under galvanostatic control at a rotating disk electrode (RDE) and in three channel flow cells by using photomacrography, SEM, and in situ time-lapse motion photography. In addition, variable-current step techniques were employed, and mass transfer limiting currents of zinc were determined using an RDE. Unlike other metals, zinc deposited from acidic halide and sulfate solutions at rates far below the mass transfer controlled region show remarkable impressions of the hydrodynamic flow. The experimental evidence supports the idea that a sharp dependence of nucleation rate, as against rate of crystal growth, on overpotential (or current density) is the principal cause for the development of striations. The nucleation rate of crystals progressively increases as the current density level is raised, dominating any preferential, outward growth of crystallites and producing a smooth surface. At the lower current density levels (far below transport limiting conditions), wakes forming behind the largest crystallites cause improved mass transport because of small decreases in the mass transfer overpotential; as a consequence, current density increases locally in the wakes. Better mass transport and smaller ohmic resistance to the developing ridges support their continued preferential growth, resulting eventually in fully striated deposits.

603 **(N—8321006) Fourth ESTEC spacecraft power-conditioning seminar.** Battrick, B.; Rolfe, E. (European Space Agency, 75 - Paris (France)). Sep 1982. 192p. (MIXED). (CONF-821188—; ESA-SP—186). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

Payload and system interfaces, original regulator/converter concepts, application of new techniques/technologies, power conditioning, energy storage and auxiliary electronics, and analysis and modelling are discussed. For individual titles, see N83-21007 through N83-21030.

604 **(N—8321008) The Marecs/ECS power subsystem.** Haines, J.E. (British Aerospace Dynamics Group, Stevenage (UK)). Sep 1982. 10p. (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

The description of a power subsystem concept that will be used with minimal modification on a series of seven communications spacecraft is presented. The subsystem is comprised of a dual wing rigid deployable panel solar array, two nickel cadmium batteries and attendant power conditioning and control equipment. A special feature of the subsystem is the shunt regulator which maintains bus voltage regulation by sequentially switching electrical sections of the solar array. Also presented are the performance parameters achieved with this subsystem and the operational modes utilised during flight.

605 **(N—8321010) The L-SAT power subsystem.** Harris, R.B.A. (British Aerospace Dynamics Group, Stevenage (UK)). Sep 1982. 5p. (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

A description of the power subsystem for the L-SAT platform is given. The system design features a modular concept so that a wide range of payload power requirements for L-SAT satellites can be met from a standard set of hardware by straightforward selection. The design of the power subsystem is based on that used in the ECS/MARECS range of satellites, but some new concepts are introduced. These include the use of nickel hydrogen batteries, and an a.c. distribution system for auxiliary and low power supplies both in the platform and payload. The power system is designed for high power missions, reflecting the capabilities of L-SAT, being extendible to power missions of up to 7.0 kW payload in sunlight and 2.5 kW in eclipse.

606 **(N—8321020) Status of European nickel-hydrogen battery development.** Gojat, P. (Societe des Accumulateurs Fixes et de Traction, 93 - Romainville (France)). Sep 1982. 5p. (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

The development of nickel-hydrogen battery technology for geosynchronous satellites is discussed. The major development activities of nickel hydrogen technology involve both cell and battery. Cycle life test results demonstrating more than 10 years of accelerated operation with depth of discharge up to 90% are presented. The battery design is a flexible one able to embody about 30 cells within the range of rated capacity of from 30 to 60 Ah. Presently two batteries comprising 28 SAFT HRN 42 S type cells (50 Ah/measured) are under development and fabrication. An engineering model and a qualification model were developed to establish and confirm the new battery concepts necessary to assemble a nickel-hydrogen battery with a particular interest for the specificity of the nickel-hydrogen cell interfaces (cylindrical shape, pressure vessel, thermal and electrical interfaces).

607 **(N—8321021) Energy generating and storing method for space application.** Dubois, Y. (Engins Matra, Toulouse (France)). Sep 1982. 12p. (French). (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

The state of the art of lithium batteries is described as well as a system for energy storage based on the use of a fuel cell plus an electrolyzer. Increased performance of lithium batteries gives this type of energy source numerous potential applications in the space domain. They constitute an irreplaceable energy source for interplanetary probes and can permit a substantial gain in mass for launch vehicles. Important progress realized with fuel cells makes the fuel cell-electrolyzer system particularly attractive for low orbit applications. The performance of the battery plus electrolyzer is analyzed and used to show the superiority of this system with respect to a system with Ni/Cd batteries.

608 **(N—8321022) Nickel-hydrogen bipolar battery system.** Thaller, L.H. (National Advisory Committee for Aeronautics, Cleveland, OH (USA)). Sep 1982. 7p. (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

Rechargeable nickel-hydrogen systems are described that more closely resemble a fuel cell system than a traditional nickel-cadmium battery pack. This was stimulated by the currently emerging requirements related to large manned and unmanned low Earth orbit applications. The resultant nickel-hydrogen battery system should have a number of features that would lead to improved reliability, reduced costs as well as superior energy density and cycle lives as compared to battery systems constructed from the current state-of-the-art nickel-hydrogen individual pressure vessel cells.

609 **(N—8321023) A high energy-density nickel-hydrogen battery design.** Miller, L. (Eagle-Picher Industries, Inc., Joplin, MO (USA)). Sep 1982. 5p. (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

A light-weight Ni-H_2 battery design concept (projected energy-density 46.7 Whr/Kg or 21.2 Whr/Lb) suitable for immediate or near-term spacecraft integration is described. The proposed design does not violate proven and qualified design concepts, or critical electrochemical component designs or functions.

610 **(N—8321024) Synthetic battery cycling techniques.** Leibecki, H.; Thaller, L.H. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1982. 6p. (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

The group of techniques that as a class are referred to as synthetic battery cycling are described with reference to spacecraft

battery systems. Synthetic battery cycling makes use of the capability of computer graphics to illustrate some of the basic characteristics of operation of individual electrodes within an operating electrochemical cell. It can also simulate the operation of an entire string of cells that are used as the energy storage subsystem of a power system.

611 **(N—8321025) Equivalent electric model of an storage battery for computerized simulation.** Dubois, Y. (Engins Matra, Toulouse (France)). Sep 1982. 8p. (FRENCH). (CONF-821188—). NTIS, PC A09/MF A01.

From 4. ESTEC spacecraft power conditioning seminar; Noordwijk, Netherlands (9 Nov 1982).

Electric and thermal models are described for storage batteries for space applications. Results obtained using the models are compared with test results and their reliabilities are validated. The structure of the model permits rapid adaptation for different types of batteries and usages, by means of interactive language. The model served to elaborate the complete model of the electric feed subsystem for the ERS-1 satellite.

612 **(N—8321056) The electrochemical fluorination of polymeric materials for high energy density aqueous and nonaqueous battery and fuel cell separators. Final Report.** Liu, C.C. (Case Western Reserve Univ., Cleveland, OH (USA)). Feb 1983. 103p. (NASA-CR—167961). NTIS, PC A06/MF A01.

A computerized system was established and the electrochemical fluorination of trichloroethylene, polyacrylic acid and polyvinyl alcohol in anhydrous hydrogen fluoride was attempted. Both solid substrates as well as membranes were used. Some difficulties were found in handling and analyzing the solid substrates and membranes. Further studies are needed in this area. A microprocessor aided electrochemical fluorination system capable of obtaining highly reproducible experimental results was established.

613 **(N—8321354) EMU battery/SMM power tool characterization study.** Palandati, C. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jan 1982. 51p. (NASA-TM—84975). NTIS, PC A04/MF A01.

The power tool which will be used to replace the attitude control system in the SMM spacecraft was modified to operate from a self contained battery. The extravehicular mobility unit (EMU) battery was tested for the power tool application. The results are that the EMU battery is capable of operating the power tool within the pulse current range of 2.0 to 15.0 amperes and battery temperature range of -10 to 40 degrees Celsius.

614 **Melting-crystallization properties of the sulphur electrolyte in sodium-sulphur batteries.** Jonz, G.J.; Rogers, D.J. (Rensselaer Polytechnic Institute, Troy, NY). *Journal of Applied Electrochemistry;* **13**: No. 1, 121-131(Jan 1983).

The present communication reports the results of some melting-crystallization studies, undertaken to characterize the thermal behaviour of the sulphur electrolyte. Heat capacities, enthalpies of transition (solid-state) and of fusion have been measured. The electrolyte is observed to have glass forming tendencies and the composition range for this behaviour is characterized. An inverse-crystallization phenomenon is observed as the sulphur content increases. The saturation solubility of sulphur is the sodium pentasulphide layer in the liquid-liquid immiscibility composition range of the sulphur electrolyte, the influence of moisture as an additive in trace amounts, and the thermal character of the chemical events in the formation of polysulphides from sulphur and Na_2S as reactants are also reported.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 969

615 **(DOE/IG—0199) Follow-up inspection of the Formerly Utilized Sites Remedial-Action Program.** (USDOE Office of Inspector General, Washington, DC). 19 Oct 1983. 16p. TIC, PO Bx 62, Oak Ridge, TN 37831.

Report to The Secretary.

Corrective actions had been taken in four of the six areas of concern that were addressed in the 1982 report. The remaining two areas are summarized as follows: Certification of Remedial Actions. We found, in the initial inspection, that FUSRAP properties were not being certified as decontaminated in a timely manner following remedial action. This problem has not yet been resolved. The Assistant Secretary for Nuclear Energy acknowledged that the certification process is lengthy but maintained that progress was being made. The Assistant Secretary stated that attempts will be made to speed up the process; and Permanent Waste Disposal. The lack of permanent repositories for FUSRAP wastes continues to be a major issue. The Assistant Secretary for Nuclear Energy indicated to us that meetings are being held with state and congressional representatives to impress on them the need for locating disposal sites for FUSRAP wastes in their states.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 121, 159, 162, 167, 168, 171, 172, 173, 174, 195

616 **(DOE/CA/10006—T2) NEP III public-participation summary: minority.** (Center for Urban Environmental Studies, Inc., Washington, DC (USA)). 24 Apr 1981. Contract FG01-81CA10006. 70p. NTIS, PC A04/MF A01. Order Number DE84001213.

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The major issues that were stressed by representatives of various minority groups were as follows: conservation; continued funding for weatherization programs; minority participation in federal research and development efforts; the adverse impact of the decontrol of oil and the proposed deregulation of natural gas; need for continuation of consumer education activities; implementation of an industry-wide affirmative action program with the emphasis on DOE service delivery systems; the utilization of various tax incentives and credits for small minority businesses; the provision of low-interest loans to minority businesses related to energy; and that specific conditions be included in any natural gas deregulation legislation that mandates a windfall profits tax and divides the proceeds into alternatives, research and development programs aimed at minority institutions and providing significant level of funding for energy assistance programs.

617 **(DOE/EIA—0035(83/10)) Monthly energy review.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Oct 1983. 107p. NTIS, PC A06/MF A01 - GPO. Order Number DE84002598.

The United States produced 7.3% less energy during the first 7 months of 1983 than during the same period in 1982, and US energy consumption through July 1983 was down 4.3% compared to the previous year. Net imports of all energy were 4.9% higher, but net imports of petroleum were down 9.7%. Energy production during July 1983 totaled 4.9 quadrillion Btu, a 5.2% decrease from the level of production during July 1982. Natural gas production fell 12.7% and coal production was down 6.7%. Petroleum production remained virtually unchanged. Production of all other forms of energy combined increased 1.9%. Energy consumption during July 1983 totaled 5.7 quadrillion Btu, 0.6% above the level of consumption during July 1982. Coal consumption increased 7.7% and petroleum consumption was up 0.6%. Natural gas consumption decreased 8.8%. Consumption of all other forms of energy combined increased 2.1%. Net imports of energy during July 1983 totaled 0.8 quadrillion Btu, 8.3% above the level of imports during July 1982. Net imports of natural gas decreased 17.7% and net imports of petroleum decreased 0.7%. Net exports of coal dropped 33.5% compared to the level in July 1982.

618 **(DOE/EIA—0219(82)) International energy annual, 1982.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Sep 1983. 102p. NTIS, PC A06/MF A01 - GPO. Order Number DE84002162.

During 1982, the world's largest energy producers were, in order, the United States, the USSR, China, and Saudi Arabia. As a group, these four countries accounted for 56% of the world's production. While many of the major energy producers experienced declines in production in 1982 as compared to 1981, the USSR reported a 3% gain resulting from increased production of natural gas. Other countries with smaller levels of energy production but notable increases during the 1973 to 1982 period were Mexico, Norway, the United Kingdom, South Africa, and Australia. Countries experiencing sizable declines in energy production over 1973 to 1982 period included Iran, Kuwait, and Venezuela. Measured by type of primary energy production, crude oil and natural gas liquids accounted for 42% of the world's primary energy production in 1982, coal for 29%, natural gas for 19%, hydroelectric power for 7% and nuclear for 3%.

619 (DOE/EIA—0425, pp 135-146) **Data and information services.** Daniels, J.E. Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

The activities of the National Energy Information Center are presented. Highlights of the NEIC are: increasing their sales of publications from zero in 1979 to over half a million dollar's worth in 1983; increasing their mailing of publications from 50,000 in 1978 to more than 1.25 million in 1983; and improving their services to be able to answer 100,000 customer inquiries a year. The EIA produces 53 periodicals, a decrease from 87 in 1978, and yet readership, revenues, and cost-savings have increased. 3 figures.

620 (ESC-WR—83-09) **Calculations with the energy model SELPE: the electricity supply in the MDE-scenarios.** Boonekamp, P.G.M. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jul 1983. 64p. (In Dutch). Available from ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Some results of scenario calculations carried out by ESC in 1982 in the framework of the Public Discussion on Energy (MDE) are presented. The calculations refer to the scenarios 'Referentie/EZ', 'Industrieel Herstel', 'Arbeidsdeling' and 'Realistisch Alternatief/CE'. The emphasis lies on the electricity supply in the different MDE senarios.

621 (EUR—8319-EN) **EFOM 12-C case studies. Candidate technologies to relieve the European energy system.** Fenhann, J. (Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development). 1983. 18p. Available from Commission of the European Communities, Luxembourg.

The aim of the present case study conducted with the linear optimization model EFOM 12C is to test the potential development and penetration into the energy system of some new energy technologies. The list of new technologies selected for the Danish part of this "Candidate technologies" case study consists only of those which have a physical potential for development in Denmark. The main result from this study is the ranking of these technologies obtained with the help of the RANGE procedure.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 122, 161, 164, 177, 233, 309, 616, 643, 660, 662, 1272

622 (DOE/AD/11263—T1) **Socio-economic impact of energy-related policy on Hispanic New Mexico: attitudes, values, and policy perceptions. Final technical report.** (New Mexico Univ., Albuquerque (USA). Southwest Hispanic Research Inst.). Dec 1982. Contract FG01-81AD11263. 151p. NTIS, PC A08/MF A01. Order Number DE84001806.

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A one-year study of the impact of energy-related policies on 584 Hispanic families in the New Mexico communities of Taos, Albuquerque and Las Cruces was conducted. Sixteen hypotheses focusing on nine energy impact issues were tested: energy use and expenditures, conservation efforts, market basket effects, employment and energy, recreation and leisure activities, transportation effects, attitudes towards energy cost, attitudes towards rate structure, and evaluation of the federal energy assistance program. Recommendations call for an energy message program geared to regional and socio-cultural factors, a companion program to solarize homes and farm structures utilizing technologies suitable to the region, incentives to private sector minority entrepreneurs equipping them with solar venture capabilities that will serve local markets and create jobs, and energy safety net and an intensive greenhouse program that will protect the market basket resources of the poor, a government policy on transportation and energy that will insure access to essential formal and informal points in the health and welfare system, and lastly, a federal-state-local partnership of financial and technical assistance options at the community level to expand energy assistance and weatherization programs.

623 (DOE/CA/10006—T1) **NEP III public-participation summary: low-income.** (Center for Urban Environmental Studies, Inc., Washington, DC (USA)). 24 Apr 1981. Contract FG01-81CA10006. 34p. NTIS, PC A03/MF A01. Order Number DE84001390.

Public testimony that pertained to low income persons considered: alternative energy sources for energy efficiency and security; natural gas deregulation; energy conservation; low cost alternatives; research programs; environmental land use issues and state or regional economic issues. (PSB)

624 (DOE/MI/10023—T1) **Cooperative Developmental Energy Program. Quarterly report, July 1-September 30, 1983.** Smith, L.S.; Anthony, J.L.; Crawford, B. Jr.; Grissom, W.A.; Washington, W.J. (Central State Univ., Wilberforce, OH (USA)). 1983. Contract FC01-83MI10023. 4p. NTIS, PC A02/MF A01. Order Number DE84001933.

This study identified constraints of employment for minorities and the growth opportunities of minority businesses in the energy field, linked minority businesses and major industries with the university, and developed a strategy and methodology for the penetration of minorities in the energy field. Activities during this quarter are discussed. (PSB)

625 (DOE/RA/50257—T2) **Research progress in industry functional modeling. Final report.** Pisano, A.D.; Giuffre, M.S. (Analytic Sciences Corp., Reading, MA (USA)). 30 Nov 1982. Contract AC01-80RA50257. 49p. NTIS, PC A03/MF A01. Order Number DE84000948.

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This two-year project focused on the development of a sound theory of modeling applicable to systems involving human, social processes in interaction with and constrained by physical processes. The first two tasks identify and classify instabilities in social models and develop model behavior near the instabilities by two different approaches. One approach involves degree to which thermodynamics and economics are analogous. The second approach is a study of the instabilities occurring in a class of models of public opinion formation. The third task is an investigation of dynamic Leontief models as industry models for both planning and forcasting. The principal objective of this work is to determine the existence of forward-recursive solutions for arbitrary initial and/or terminal conditions. The fourth task is an investigation into the well-posedness of connected systems of models. The main feature of these results are conditions for the insensitivity of the solutions of models of interconnected systems to parametric errors. The final task is an investigation of decision making as it relates to power plant operations of a typical fossil-fired power plant. An objective of this work is to develop a conceptual design of a computer-based decision aid, using concepts from Artificial Intelligence, to assist the operator in on-line performance optimization.

626 (NP—4900194) **Mineral revenues: the 1982 report on receipts from Federal and Indian leases with summary data from 1920 to 1982.** (Minerals Management Service, Washington, DC (USA). Royalty Management Program). 1983. 74p. NTIS, PC A04/MF A01. Order Number DE84900194.

In 1982, bonuses, rents, and royalties from Federal and Indian leases together totaled $9.3 billion. These revenues were dis-

tributed to the states, to the general fund of the Treasury, to certain earmarked accounts, and to Indian tribes and allottees. This annual report contains updated tabulations of royalty collections from mineral leases on Federal offshore and onshore lands and on Indian lands. Oil royalties taken in kind are also detailed. 10 figures, 25 tables. (ACR)

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 283, 1157, 1191, 1267, 1268, 1271, 1377

627 **(AD-A—130196/9) Determination of the impact of environmental regulations on Army unit training. Final report.** Bandy, J.T.; Young, V.T. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jun 1983. 25p. (CERL-TR-N—156). NTIS, PC A02/MF A01.

This report presents the results of a study which assessed the effects of Federal environmental laws and regulations on Army unit training. A survey/questionnaire was prepared and distributed to all Forces Command (FORSCOM) installation environmental coordinators and Division/Separate Brigade-level training officers. Two installations were visited to obtain a more detailed evaluation. The surveys and visits showed that only minimal training capabilities were lost due to compliance with environmental regulations. Most potential problems can be avoided through coordinated planning during the earliest stage of facility development.

628 **(ANL/EES-TM—229) Costs and air-quality impacts of alternative national ambient air-quality standards for particulate matter.** Smith, A.E.; Brubaker, K.L. (Argonne National Lab., IL (USA)). Jan 1983. Contract W-31-109-ENG-38. 124p. NTIS, PC A06/MF A01. Order Number DE84001193.

This technical support document describes the analysis system used to estimate the air quality impacts and the direct industrial costs associated with implementation of alternative national ambient air quality standards for particulate matter. These results were intended to be used in support of a Regulatory Impact Analysis of the alternative standards both directly and indirectly as input data to further economic analyses and analyses of benefits. The current system is an expansion and modification of an earlier system developed by Energy and Environmental Analysis (EEA). Significant modifications of the EEA system were required in order to provide, among other things, a complete, consistent treatment of growth and retirement, a consistent treatment of area sources, and the capabiity to handle PM10. Both systems are implemented in a series of computer codes.

629 **(EPA—4900198) Can we delay a greenhouse warming.** Seidel, S. (Environmental Protection Agency, Washington, DC (USA). Office of Policy Analysis). Sep 1983. 205p. NTIS, PC A10/MF A01. Order Number DE84900198.

Evidence continues to accumulate that increases in atmospheric carbon dioxide (CO_2) and other greenhouse gases will substantially raise global temperature. While considerable uncertainty exists concerning the rate and ultimate magnitude of such a temperature rise, current estimates suggest that a 2°C (3.6°F) increase could occur by the middle of the next century, and a 5°C (9°F) increase by 2100. Such increases in the span of only a few decades represent an unprecedented rate of atmospheric warming. Temperature increases are likely to be accompanied by dramatic chages in precipitation and storm patterns and a rise in global average sea level. As a result, agricultural conditions will be significantly altered, environmental and economic systems potentially disrupted, and political institutions stressed. Responses to the threat of a greenhouse warming are polarized. This study aims to shed light on the debate by evaluating the usefulness of various strategies for slowing or limiting a global warming. This study takes a first look at whether specific policies aimed at limiting the use of fossil fuels would prove effective in delaying temperature increases over the next 120 years. These policies are also evaluated for their economic and political feasibility. To put our findings in persepective, alternative, nonenergy approaches to limiting a greenhouse warming are also reviewed. 63 references.

630 **(OTA—3910805) Coastal zone management and access to onshore minerals on nonfederal lands: a threshold assessment.** Theberge, N.B.; Whitney, S.C. (Virginia Inst. of Marine Science, Gloucester Point (USA); College of William and Mary, Williamsburg, VA (USA)). [nd]. 63p. NTIS, PC A04/MF A01. Order Number DE83910805.

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This report identifies possible areas of conflict between state Coastal Zone Management plans and access to minerals to avoid unnecessary and costly regulatory constraints on needed mineral development. Current state laws and planning programs for Virginia, North Carolina and South Carolina as they relate to mining and mineral access are summarized. Existing mining operations are inventoried including kinds of minerals extracted, location of operations, and the attitude of the mining industries operating in the coastal zone of each state.

631 **(PB—83-235283) Water rights transfers: a legal, economic, and informational analysis of water in Oregon. Final technical report.** Kraynick, R.G.; Whittaker, G.W.; Bhadra, B.P.; Stoevener, H.H.; Huffman, J.L. (Oregon State Univ., Corvallis (USA). Water Resources Research Inst.; Lewis and Clark Coll., Portland, OR (USA). Natural Resources Law Inst.). May 1983. 339p. (WRRI—78). NTIS, PC A15/MF A01.

The doctrine of prior appropriation (DPA) poses theoretical and practical constraints on decentralized exchanges of water rights, owing to universal non-impairment provisions in statutes of states using DPA. Five issues concerning efficacy of DPA water right transfer system in Oregon were explored: administrative, legal, economic, joint legal-economic, and informational.

632 **(PB—83-236083) Pilot program to evaluate the effectiveness of OSHA (occupational safety and health act) construction standards at the point of erection. Final report.** Pals, J.; Kane, J.; Marcello, J. (Western Inst. for Research and Education, Inc., Denver, CO (USA)). 15 Jan 1982. 217p. NTIS, PC A10/MF A01.

Both labor and management in the construction industry are concerned with the enforcement of four OSHA construction standards (regarding the use of safety belts, nets, and training) at the point of erection. This concern prompted this project which is a pilot program to evaluate the effectiveness of these standards at the point of erection in steel and precast/prestressed erection. To accomplish this objective, nine erection sites of various kinds were visited; contacts were made with unions, contractors, associations, and various OSHA officials; and data was obtained regarding fall accidents occurring at the point of erection.

633 **Institutional aspects of indoor air pollution in energy efficient residences.** Everett, J.J. (Sandia National Lab., Albuquerque, NM); Dreher, T.J. *Environment International;* 8: No. 1-6, 525-531(1982). (CONF-811048—).

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This paper examines the institutional constraints regarding indoor air pollution that exist or may be imposed on the housing industry. These constraints may be manifested in building codes and health laws, tax incentives and spending subsidies, and/or regulations restricting the activities of the industry itself. It also assesses the potential liabilities of designers, manufacturers, builders, and owners of energy-efficient residences should they fail to take appropriate actions to address indoor air quality problems. These liabilities may result from product liability (defective design or manufacture), breach of warranty, or negligence, causing harm to people from indoor air pollution.

2904 Natural Resources

634 **(NP—4900250) Marketable energy resources in Alabama: a partially annotated research bibliography.** (Alabama Office of State Planning and Federal Programs, Montgomery (USA). State Planning Div.). Apr 1982. 73p. Office of State Planning and Federal Programs, 3734 Atlanta Highway, Montgomery, Alabama 36130.

This bibliography provides a guide to the published research, both basic and applied, on the commercial potential and possible energy contribution of selected domestic renewable and non-renewable energy resourecs in Alabama. Some of the renewable and non-renewable energy resources documented in published form and highlighted in this bibliography include coal, oil, small-scale hydroelectric power, natural gas, wind energy, waste wood, and uranium. One renewable resource that has been purposely excluded has been solar energy. The information for this publication was derived from a number of sources: the Geological Survey of Alabama, Office of State Planning and Federal Program's Planning Reference Service, US Department of Energy's Technical Information Center at Oak Ridge, Tennessee, School of Mines and Energy Development of the University of Alabama, Mineral Resources Institute and State Mine Experiment Station of the University of Alabama, and other organizations, some of which are listed in the energy organizations directory of this publication. A subject index is included. Terms used in the index are listed alphabetically on a word to word basis, as derived from the actual titles and annotations listed in the bibliography.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 119, 466, 657

635 **(GSI—83-1) GSI scientific report 1982.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Mar 1983. 366p. NTIS (US Sales Only), PC A16/MF A01. Order Number DE83751322.

This annual report contains extended abstracts about the work performed by the named society. These concern nuclear reactions, nuclear structure, exotic nuclides, nuclear theory, superheavy quasi-atoms, interactions of heavy ions with matter, biological and physical radiation effects, the development of targets, experimental set-ups, radiation detectors, and counting electronics, the UNILAC accelerator, as well inertial confinement fusion. Furthermore a list of publications is added.

636 **(N—8324429) Resource Conservation and Recovery Act Reauthorization.** (Committee on Energy and Commerce (U.S. House), Washington, DC). 1982. 42p. (GPO—89-081). Avail: US Capitol, House Document Room.

GPO Presented to the Comm. of the Whole Hours on the State of the Union, 97th Congr., 2d Sess., 18 May 1982.

Areas of concern discussed, included: state hazardous waste programs, resource conservation and recovery, hazardous waste site inventory, and recycled oil programs.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 232, 233, 283, 498, 502, 558, 566, 618, 645, 1191

637 **(WBZ-P—82-5) Strategies and deficits in the political treatment of technical risks.** Dierkes, M.; von Thienen, V. (Wissenschaftszentrum, Berlin (Germany, F.R.)). 1982. 25p. (In German). (CONF-8109239—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751323.

From Regional conference: state measures against hazards in the industrial society; Wiesbaden, F.R. Germany (23 Sep 1981).

To seek approaches for an explanation of the public debate about certain technological risk sources, the authors present an analytical model of risk management techniques. It permits to describe traditional patterns of risk management which frequently are not based on rational categories and pursue a limited number of aims in strategic steps. It concentrates on single major events (catastrophies) and the mistigation of such damage and points out that some risk management techniques related to the utilization of new technologies, unlike the complex traditional forms of risk management, are increasingly aimed at preventing damage occurring in the first place. The chances for a more systematic and acceptable risk management satisfying the growing demands of developing modern technologies are discussed.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 729, 747

2910 Conservation

REFER ALSO TO CITATION(S) 671, 672, 675, 677, 694, 709, 722

638 **(ESC-WR—83-21) Incentives and impediments for industrial energy saving.** Over, J.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Aug 1983. 36p. (In Dutch). Available from ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Industrial energy saving is strongly influenced by possible financial incentives and impediments. Although there is an extensive saving potential, realization is slow because of the following causes: the relative importance of energy costs with respect to other production costs differ for different types of industry. Some industries have more reason to invest in energy saving than others; investments in energy saving have in many cases a defensive and optional character, which affects the priorities; in some cases there are serious production risks; there might be a capital shortage or a lack of perspectives. Investments in energy saving are related to energy prices and production costs as experienced by industries. In a limited way government is capable in modifying investment decisions by industries. The instruments of government are an increase of energy prices and a reduction in investment costs. The advantages and disadvantages of these two instruments are discussed.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 164, 169, 170, 171, 175, 656, 663, 664, 736

639 **(EUR—8543-EN) European energy-supply studies using the EFOM 12D model. Final report.** Clifford, J.S.; Laughton, M.A.; McRoberts, T.S.; Slee, P.V. (Queen Mary Coll. Industrial Research Ltd., London (UK)). 1983. 196p. European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

The progress made to date with the polynational polyperiod (PNPP) model (also referred to as the 12D model) is described. Earlier reports have dealt with details of model structure, listed the coding conventions used in placing the energy supply and utilization subsystems in the GENERIC modelling framework and discussed the preliminary results obtained. Here the essential aspects of the model structure are reviewed, with particular reference to recent developments, and the results of case studies are presented. Cost and capacity data were obtained from the mononational 12C data bases and demand data from the same source. Constraints were imposed on total cash flow to energy supply activities to ensure that each subset of national results in the multinational study approximated reasonably to the individually determined MN5P, or single nation model, results.

640 **(EUR—8593-EN) Energy supply and demand in the European Communities with regard to the world market. Final report.** Sassin, W. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). 1983. 24p. European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

The report endorses a two-part study done by the International Institute for Applied Systems Analysis (IIASA) for the Commission of the European Communities called Fuelling Europe in the Future and The long-term Energy Problem: Alternative R and D strategies. The limitations of this and other technological analyses are discussed against the background of changes in national and international energy markets since the mid-1970s. Backed up by a quantitative analysis of potential advantages, reasons are given why the Community should undertaken energy modelling research that takes account of the tendencies towards instability in the international economy.

641 **(N—8323213) Gasoline shortfall management.** Prins, V. (Van Wyk and Louw, Inc., Pretoria (South Africa)). 1982. 23p. NTIS, PC A20/MF A01.

Two aspects of a gasoline shortfall are emphasized: options available to the government to deal with it and the requirements for a quantitative methodology to evaluate these options. To answer these questions the the US experience of shortfalls is sketched, a conceptual framework from within which to view a shortfall is developed, and a methodology to evaluate different policy alternatives from an efficiency as well as an equity perspective is outlined.

642 **(PB—83-241026) EFOM case studies: the escalating supply rationing (germany). Final report.** Huber, W.; Leimkuehler, K.; Pierotti, F. (Commission of the European Communities, Luxembourg). [nd]. 119p. (EUR—8050-EN). NTIS, PC E06/MF E06.

National case studies carried out using EFOM 12C are reported for the Federal Republic of Germany (FRG). After a brief description of the energy system of the FRG the exogenous factors used in the model are reviewed. Three extreme cases are specified for case studies, but in order to achieve a more realistic perspective a further two cases are defined.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 128, 323, 675, 1272

643 **(AD-A—130313/0) Peace and war: a study of morality and US strategic nuclear policies. Study project report.** Ginder, D.B.; Hicks, I. (Army War Coll., Carlisle Barracks, PA (USA)). May 1983. 52p. NTIS, PC A04/MF A01.

The paper examines the quesitons of peace and war and the morality of nuclear deterrence. These vital and enduring questions have been again become a focus of societal debate, especially in the light of the Catholic Bishop's pastoral letter. The nuclear debate is all encompassing, raising philosophical, political, social, strategic an religious questions. These issues present problems that each informed citizen will have to discern both morally and politically. The purpose of the paper is not to evaluate the morality of the defense and deterrent policies/strategies of the United States, but to provide the reader with the information to allow him to formulate judgment on this important question and be able to reconcile personal moral values with national policy and strategy.

644 **(DOE/S—0010(83)) Secretary's annual report to Congress.** (USDOE, Washington, DC). Sep 1983. 174p. NTIS, PC A08/MF A01 - GPO. Order Number DE84002534.

National energy policy is summarized and progress made and major policy initiatives are described. Total US energy efficiency has increased, domestic energy sources are being developed more effectively, prices have declined, dependence on foreign energy sources has diminished, and vulnerability to energy supply dissruption has been reduced. Developments are reviewed in conservation, renewable energy resources, fossil fuels, nuclear energy, energy supporting research, general sciences, environment, health and safety, emergency preparedness, international programs, nuclear non-proliferation, defense, energy information, economic regulation, and departmental administration. Appendixes include: foreign direct investment in US energy in 1981, exports of energy resources by foreign countries, disclosure of energy assets by DOE employees, financial assistance programs, and Office of Hearing and Appeals private grievances and redress.

645 **(KFK—3342) Big technologies in the public controversy.** Frederichs, G.; Bechmann, G.; Gloede, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse). May 1983. 252p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE83751341.

The formation of new social movements which have rendered the criticism of technological development a societal and political issue, was the motive for empirically testing the societal dimensions of the conflict over technology and its linkage with processes of social change. A representative survey of 2000 people living in the Federal Republic of Germany and West Berlin showed characteristic opinion trends among groups of the population concerning the central topics energy policy, nuclear energy, and coal, and these are related to social-structural factors. Critique of industrialism proves to be - apart from a more "populistic" environmentalist attitude - a relevant factor for evaluating issues of technology policy. Three main critical trends emerge which structure the public debate about energy policy: a critique which is technology specific, a generalising criticism derived from critique of industrialism, and an increasingly radical critisicm guided by post-materialistic value orientations.

646 **(N—8323716) Federal Power Act Amendments of 1982.** (Committee on Energy and Natural Resources (U.S. Senate), Washington, DC). 1982. 120p. (GPO—09-140). Avail: Subcommittee on Energy Regulation.

In Hearing on S. 2500 before the Subcomm. on Energy Regulation of the Comm. on Energy and Natural Resources, 97th Congr., 2d Sess., 22 Jul. 1982.

Testimony on a bill to amend the hydroelectric licensing provisions of the Federal Power Act is presented.

647 **(N—8323717) Energy initiatives of the 96th Congress.** (Committee on Energy and Natural Resources (U.S. Senate), Washington, DC; Library of Congress, Washington, DC (USA)). Jun 1982. 255p. (PUBL—97-73; GPO—94-897). Avail: Committee on Energy and Natural Resources.

Rept. presented by the Comm. on Energy and Nat. Resources, 97th Congr., 2nd Sess., Jun. 1982.

The Energy Security Act of 1980 is discussed. Fossil fuels energy policy, nuclear power issues, solar and renewable energy research and development, energy conservation programs, and organizational policy are also discussed.

648 **(N—8323718) US participation in the International Energy Program.** (Committee on Energy and Natural Resources (U.S. Senate), Washington, DC). 1982. 87p. (GPO—95-065). Avail: Committee on Energy and Natural Resources.

In Hearing on S. 1937 before the Comm. on Energy and Natural Resources, 97th Congr., 2d Sess., 4 Feb. 1982.

Issues relating to the international energy program, including issues concerning U.S. participation are considered. Extending participation of U.S. oil companies in the international energy program is also considered.

649 **(N—8323719) Department of Energy research and development programs.** (Committee on Energy and Natural Resources (U.S. Senate), Washington, DC). 1983. 893p. (GPO—12-484). Avail: Subcommittee on Energy Research and;Development.

Conservation and renewable energy program budget requests are reviewed.

650 **(N—8323742) National research and development program in the energy field.** (Serice de la Programmation de la Politique Scientifique, Brussels (Belgium)). Jun 1982. 76p. (In French). NTIS, PC A05/MF A01.

Scientific, technological, and economic criteria were established to clarify, in a total context, the choices open to Belgium in meeting the energy crisis and in reducing dependence on foreign sources of fuels and strategic materials. Mathematical models were developed to describe the energy supply and demand in both the industrial and residential sectors. For the period from 1982 to 1987, activities concentrate on analyzing the energy system determining reasonable use of energy in all sectors, investigating fossil energy and the energetic vectors of substitution and biomass, automating processes for the production of solar cells and the development of solar receivers and photovoltaic systems, and recycling and stockpiling strategic materials. A documentation center was established to evaluate national and international research results.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 94, 119, 121, 122, 128, 142, 156, 158, 159, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 176, 177, 179, 195, 196, 617, 618, 626, 645, 648, 657, 657, 714

651 **(DOE/EIA—0130(83/10)) Natural gas monthly.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Oct 1983. 115p. NTIS, PC A06/MF A01 - GPO. Order Number DE84002275.

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Highlights include: marketed production of natural gas during August was estimated at 1318 billion cubic feet (Bcf), 10.4% below the August 1982 level; consumption during August was an estimated 1085 Bcf, a decrease of 5.5% compared to August 1982; natural gas consumption in July, compared to the previous July, was down in all market sectors; the volume of working gas in underground storage reservoirs at the end of August was 3.3% below the August 1982 level; the average wellhead price of natural gas in June 1983 was $2.53 per thousand cubic feet Mcf, up 11 cents from June 1982; in August 1983, the US city average residential price for 100 therms of natural gas was $6.58 per Mcf as compared to $5.56 per Mcf in August 1982; the average wellhead price for natural gas purchases projected for September 1983 was $2.64 per Mcf. In September 1982 the average price was $2.54 per Mcf. The average price projected for Old Gas (NGPA Sections 104, 105, and 106) in September 1983 was $1.24 per Mcf, for New Gas (NGPA Sections 102, 103, 108, and 109) $3.43 per Mcf, and for High Cost Gas (NGPA Section 107) $6.25 per Mcf. In September 1982 the prices projected for Old Gas, New Gas, and High Cost Gas averaged $1.35, $3.26, and $7.33 per Mcf, respectively; and a selected group of natural gas companies estimated that 2.4 trillion cubic feet of surplus deliverability was available for offsystem sales during the six-month period July through December 1983. An overview of the Mexican natural gas situation is presented. (PSB)

652 **(N—8323715) Final 5-year plan for oil and gas development in the outer continental shelf.** (Committee on Energy and Natural Resources (U.S. Senate), Washington, DC). 1982. 193p. (GPO—11-566). Avail: Subcommittee on Energy Conservation and Supply.

In Hearing before the Subcomm. on Energy Conserv. and Supply of the Comm. on Energy and Natural Resources, 97th Congr., 2d Sess., 8 Sep. 1982.

The five year plan for oil and gas development in the outer continental shelf was discussed, considering such aspects as protecting marine, coastal, and human environments, as well as, our energy needs.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 1173

653 **(DOE/CS/60124—T1) North Carolina Energy Institute annual report, July 1, 1981-June 30, 1982.** Bresee, J.C.; Holleman, M.S. (North Carolina Dept. of Commerce, Raleigh (USA). Energy Div.). 1982. Contract FG44-78CS60124. 86p. NTIS, PC A05/MF A01. Order Number DE84001095.

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This is the final report from the North Carolina Energy Intitute, which ended its activities on June 30, 1982. It contains final reports from twenty-three projects sponsored by the Institute and status reports for fifteen which were not complete at the termination of the Institute program. The seven most significant projects involved four sources of alternative energy for which North Carolina has special advantages: wood, peat, methanol, and passive solar.

654 **(DOE/MA—0004/2) In-House Energy Management annual report, FY 1983.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Facility Planning and Support). Sep 1983. 54p. NTIS, PC A04/MF A01. Order Number DE84001576.

A summary of activities and an evaluation of progress toward the achievement of energy consumption and energy efficiency goals, through fiscal year 1982, as established by the Department in its 10-Year Management Plans is presented. The mission, organizational structure and reporting relationships of the Department of Energy and of the Department's field offices are shown.

655 **(N—8323766) Hydrogen technology.** Peschka, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 173-178 (SEE N83-23743 13-44).

The elements of an energy economy based mainly on hydrogen are discussed. Large scale production of non-fossile hydrogen from nuclear and solar energy, long-distance transport on an international scale including the associated possibilities of decoupling production and consumption, storage and distribution at home including the various types of coupling possible during conversion, and the use of hydrogen as an energy carrier in the various consumer sectors are discussed. Use of chemicals, iron and steel, in the upgrading of fossile energy carriers and in the production of synthetic liquid hydrocarbons is also discussed.

656 **(N—8323767) Large scale solar energy utilization possibilities and restrictions.** Nitsch, J. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 179-184 (SEE N83-23743 13-44).

The basic problems of producing hydrogen and introducing it into our energy system are described. It is discussed in what time and under which conditions solar hydrogen can make an essential contribution to our energy economy. Solar thermal and photovoltaic power plants for the electrolytic production of hydrogen are described. Typical values for the amount of the financial investment as well as for the raw material requirements are given. It is concluded that a sizeable portion (up to 50%) of our energy could be supplied by solar hydrogen in the year 2030.

657 **(NP—4900014) Federal synthetic-fuels program: a review.** Roach, R.; Matheson, J. (Environmental Policy Inst., Washington, DC (USA)). Jul 1983. 50p. Environmental Policy Institute, 317 Pennsylvania Ave. S.E., Washington, DC 20003.

The status of the synthetic fuels projects and Synthetic Fuels Corporation (SFC) was reviewed. Results reveal that the program is falling far short of the lofty goals envisioned by the authors of the Energy Security Act. The authors conclude that it would be unwise to commit a significant portion of the nation's energy budget to the rapid commercialization of immature and uneconomic technologies. A more appropriate strategy would be to establish and development a program which requires cost-sharing on the part of the private sector and provides for the collection of data on technical performance, environmental impacts, and economic feasibility. Discussion is presented under the headings: ignoring the market and technological realities of an immature industry; the subsidization of high-cost energy alternatives; the SFC - indiscriminate promoter of synfuels; SFC subsidies; SFC's environmental program; energy security - the great myth of synthetic fuels; and the SFC - a source of lavish salaries and benefits. (DMC)

2960 Electric Power

REFER ALSO TO CITATION(S) 479, 620

658 **(DOE/ET/29366—T2) Research and development of a methodology for the emergency state control for electric-energy systems. Final report.** Usoro, P.B.; Rouhani, R. (Scientific Systems, Inc., Cambridge, MA (USA)). Mar 1983. Contract AC01-79ET29366. 52p. NTIS MF A01. Order Number DE84001753.

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This report presents the development of a stochastic approach to solving the emergency state control problem in electric power systems. It identifies slow speed dynamics and cascading failures as characterizing many major electric power system collapses and presents a probabilistic representation of the uncertain changes in power system's configuration. The control algorithm looks several time steps ahead to account for system uncertainty and is aimed at guiding the system from emergency state back into a normal state in an optimal fashion. Algorithms for performing the constrained nonlinear optimization arising from the control computation are reviewed and a state-of-the-art multi-purpose nonlinear optimization code is recommended. The main contribution of this research project is that the uncertainty in power system dynamics is clearly addressed and the emergency state control problem is formulated as a stochastic control problem to reflect the true nature of the system. Furthermore, the stochastic control problem is solved using a sequential decision tree strategy with manageable computational requirements.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 714

659 **(DOE/RG/10409—T1) Hayden Station powerplant maintenance system: preventive-maintenance program. First interim progress report.** (Colorado-Ute Electric Association, Inc., Montrose (USA)). 24 Oct 1983. Contract FG01-80RG10409. 179p. NTIS, PC A09/MF A01. Order Number DE84002005.

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Progress is reported on the following objectives to: perform a benefit/cost evaluation of a preventive maintenance program designed to enhance the availability of a central station power plant and document the program at a level of detail which will assist other utilities in making a decision as to whether or not to implement a preventive maintenance program.

660 **(P—110-82-005) Delivering energy services: the emerging role of California's municipal utilities.** Dawson, M.H.; Praul, C.G.; Marcus, W.B. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Nov 1982. 191p. California Energy Commission, 1516 9th Street, Sacramento, CA 95814.

The financial circumstances and energy service opportunities for California's municipal electric utilities are explored. The structure and financial operation of municipal utilities, including the new role of joint powers agency financing, are analyzed. The advantages which conservation and alternative energy resources can offer municipal utilities are discussed: reduced capital requirements, increased cash flow, oil displacement, improved air quality, reduced risk of large plant outages, and matching new capacity to uncertain load growth. Recommendations are presented for removing the existing barriers which discourage prospects for municipal utility energy service investments, such as wholesale rate design reflecting flat or declining block rates and high demand charges, control of bulk power transmission lines by investor-owned utilities, failure of federal power-marketing agencies to provide conservation incentives to their municipal utility customers, and tax credit provisions of the Crude Oil Windfall Profit Tax Act of 1980. Appendices include the municipal utilities' current resource plans, the history and process of the formation of new municipal utilities, and the energy service role of municipal agencies in cities which may not have municipal utilities.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 299, 309, 323, 372, 455, 458, 466, 469, 618, 653, 656

661 **(DOE/CS/65002—T2) County energy-production handbook.** Woolson, A. (National Association of Counties Research Foundation, Washington, DC (USA)). Oct 1981. Contract FG01-80CS65002. 98p. NTIS, PC A05/MF A01. Order Number DE84001866.

Chapter I discusses the relations between energy costs, energy supply, and the economic well-being of the community, examples of local governments that have integrated energy considerations into their economic development plans are discussed. Chapter II examines the range of renewable technologies that can be developed by county residents and local governments. Examples are presented of communities already benefiting from renewable projects. Institutional barriers to renewable energy are examined in Chapter III. Positive steps taken by counties and states to remove these barriers and to ensure solar access are explained, along with examples of what counties can accomplish with different legal authorities. Chapter IV reviews the comprehensive energy planning process needed for an integrated equitable, and community-supported energy program. The role renewable energy development can play in such plans is noted. Finally, Chapter V gives an overview of local and state technical resources and funds and federal programs that local governments can employ to develop energy projects. A resource list and bibliography give additional references and contacts related to topics covered in the book.

662 **(N—8323765) Photovoltaic applications in Europe: System economics and market prospects.** Starr, M.R. (Halcrow (William) and Partners, Swindon (UK)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources, Technol., Potential p 165-170 (SEE N83-23743 13-44).

After reviewing the prospects for cost reduction, the economics of electricity generation by photovoltaics in comparison with conventional alternatives are discussed. The important influence of various financial incentives for purchasers is demonstrated. Economic analyses are also presented for small-scale stand-alone photovoltaic systems for pumping and refrigeration. Finally, the market prospects for photovoltaic applications in Europe are reviewed, on the assumption that this technology is given official support and encouragement by national governments, electricity utilities and private investors.

663 **(N—8323768) Other means for direct and indirect use of solar energy.** Ley, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Nov 1982. 6p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In ESA Solar Energy 1982: Resources Technol., Potential p 185-190 (SEE N83-23743 13-44).

The direct and indirect uses of solar energy are discussed. Indirect solar energy conversion like wind, wave and tides, water flows or elevated water, ocean thermal and biological materials are considered. All of them are of interest today as possible future energy sources primarily because of their nondepletable character and their favorable environmental aspect, in comparison with energy technologies presently in use.

664 **(N—8323770) Round table discussion on the future of solar energy.** Strub, A.S.; Bloss, W.H.; Claverie, M.; Faninger, G.; Winter, C.J. (European Space Agency, 75 - Paris (France)). Nov 1982. 4p. (CONF-820799—). NTIS, PC A12/MF A01.

From Summer school in ESA solar energy 1982: resources, technologies, potential; Igls, Austria (28 Jul 1982).

In Solar Energy 1982: Resources, Technol., Potential p 201-204 (SEE N83-23743 13-44).

The future of solar energy technology in industrialized countries and developing nations was discussed. Solar technologies were compared. Policies, trends, and efforts in various countries were discussed. A review of photosynthesis was given.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 612

665 **(DOE/ET/10815—82) MHD Coal-Fired Flow Facility. Quarterly technical progress report, April-June 1982.** (Tennessee Univ., Tullahoma (USA). Space Inst.). Aug 1983. Contract AC02-79ET10815. 92p. NTIS, PC A05/MF A01. Order Number DE84001625.

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In this Quarterly Technical Progress Report, UTSI reports on progress in the DOE MHD Development Program in design of test components, operation of the DOE Coal Fired Flow Facility, testing and analysis of test data. During the quarter the LMF1A test series was completed. The primary objective of the test series was to complete the shakedown of the CFFF and to shakedown the Low Mass Flow Train. The shakedown test series was preparatory to subsequent testing to obtain comprehensive NO/sub x/ and SO_2 emissions data. In the design and fabrication of Low Mass Test Train hardware components, the brazing of cladding materials onto the caps for the 45° Diagonal Conducting Wall Generator was substantially completed. The Superheater Test Module (SHTM) was in the detailed design phase. Bids were received for commercial air heaters, however, none of the bids were acceptable and plans are reported to reinitiate the request for bids. The candidate particulate removal systems, electrostatic precipitator and/or baghouse, were under study for the best technology to meet the requirements. Analysis of the particulate removal requirements and anticipated problems in the application to an MHD system are presented. Preliminary results of the LMF1A test series, which was completed during the quarter, are presented. Results of the environmental measurements are reported. The preparation of a draft environmental plan was completed. A one-dimensional radiation heat transfer program which will be used to predict the temperatures, cooling rates and residence times in the radiant furnace, is discussed. A report is presented of a simplified three-dimensional generator code along with typical results. A preliminary report on the results of cold flow modeling of the secondary combustor is included.

666 **(DOE/ET/10815—85) Development of vitation heater for the Coal-Fired Flow Facility.** Schulz, R.J.; Kulesza, P.R.; Smith, G.D.; Johanson, N.R. (Tennessee Univ., Tullahoma (USA). Space Inst.). Aug 1983. Contract AC02-79ET10815. 24p. NTIS, PC A02/MF A01. Order Number DE84001630.

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The UTSI MHD Combustor System uses an oil fired vitiation heater to preheat the oxidizer, a mixture of nitrogen and oxygen gases, prior to injection into the primary coal/oil combustor. This topical report describes the development and modifications necessary to make the vitiation heater a practical device for long term operation in the Coal Fired Flow Facility.

667 **Conceptual design of a superconducting magnet for a 200 MW /SUB e/ MHD engineering test facility.** Marston, P.; Dawson, A.; Hatch, A.; Thome, R. (Massachusetts Instit. of Tech., Cambridge, MA 02139). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* 19: No. 3, 867-871(May 1983).

A 6 T superconducting magnet system conceptual design has been completed for the U.S. Department of Energy's 200 MW / SUB e/ Engineering Test Facility. The 1000 tonne magnet will be built of two grades of pool-cooled NbTi cable superconductor supported in 26 layers of stacked epoxy-plastic plates which form each 60° rectangular saddle coil half. Each coil half will be enclosed in a stainless steel vessel which contains the liquid helium that cools the coils and provides some structural support against the electromagnetic forces. The main force containment structure, external to the LHe vessels and located in the vacuum chamber, is designed for maximal access to structural and coil containment vessel welds for purposes of routine inspection. An LN_2-cooled thermal radiation shield is situated between the force containment structure and the outer vacuum vessel. Fiberglass-epoxy low-heat-leak struts position and hold the cold mass in place in the vacuum vessel and also withstand gravity, seismic and magnetic interaction loading. The magnet system, warm bore liner and roll-aside mechanism provided for channel changeout will be discussed as well as such interfacing considerations as fringe field effects on personnel and control instrumentation.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 607

668 **(ANL—83-34) Advanced fuel-cell development. Progress report, January-March 1982.** Pierce, R.D.; Arons, R.M.; Briendel, A.M.; Kucera, G.H.; Sim, J.W.; Smith, J.L.; Stapay, J.R. (Argonne National Lab., IL (USA)). Aug 1983. Contract W-31-109-ENG-38. 42p. NTIS, PC A03/MF A01. Order Number DE84001553.

This report describes fuel cell research and development activities at Argonne National Laboratory (ANL) during the period January through March 1982. These efforts have been directed toward (1) evaluating the dissolution of NiO cathodes in molten carbonate fuel cells and (2) seeking alternative cathode materials. Solubility data were taken for NiO in a cathode environment, and previously operated cells were examined for nickel transfer. A literature search was made for prospective alternative cathode materials, and synthesis of new materials was begun. Apparatus was assembled for conductivity measurements on cathode materials.

669 **(ANL—83-67) Advanced fuel-cell development. Progress report, April-June 1982.** Pierce, R.D.; Briendel, A.M.; Kaun, T.D.; Kucera, G.H.; Sim, J.W.; Smith, J.L.; Stapay, J.R. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01. Order Number DE84002685.

This report describes fuel cell research and development activities at Argonne National Laboratory (ANL) during the period April through June 1982. These efforts have been directed principally toward seeking alternative cathode materials to NiO for molten carbonate fuel cells. In earlier work a list of alternative cathode materials was derived from a literature search. These candidate materials are being synthesized and then pressed into discs for testing of their conductivity and stability. Testing in this period showed $Ca_{1.7}Y_{0.3}MnO_4$ to be worthy of further study as a cathode material. In addition, solubility data were taken for NiO in a cathode environment and found to vary inversely with temperature from 823 to 1017 K.

670 **(DOE/FE/60338—T1) Phosphoric acid electric-utility fuel-cell technology development. Technical progress report No. 2 for quarter ending June 1983.** Congdon, J.V.; Goller, G.J.; O'Brien, J.J.; Randall, S.A.; Rothlein, R.J.; Sandelli, G.J.; Szymanski, S.J. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1983. Contract AC01-83FE60338. 22p. NTIS, PC A02/MF A01. Order Number DE84001136.

The Department of Energy has initiated this program to advance electric utility cell stack technology and to reduce cell stack cost. The cell stack has a nominal 10-ft^2 active area and operates at 120 psia/405°F with an initial average cell performance goal of 0.745 volts at 232 ASF. The program comprises six parallel phases, which culminate in a full-height, 10-ft^2 stack verification test: (I) provides the information and services needed to manage the effort, including definition of the prototype commercial power plant; (II) develops the technical base for long-term improvements to the cell stack; (III) develops materials and processing techniques for cell stack components incorporating the best available technology; (IV) provides the design of hardware and conceptual processing layouts, and updates the power plant definition of Phase I to reflect the results of Phases II and III; (V) manufactures the hardware to verify the achievements of Phases II and III, and analyzes the cost of this hardware; and (VI) tests the cell stacks assembled from the hardware of Phase V to assess the state of development. Progress is reported. (WHK)

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

671 **(DOE/CE—0016/2) Annual report to the President and the Congress on the State Energy-Conservation Program for calender year 1982.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Energy Management and Extension Div.). Jul 1983. 16p. NTIS, PC A02/MF A01. Order Number DE84002554.

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The activities of the seventh year's operation of the State Energy Conservation Program, December 1981 through December 1982, are reported. Included are discussions regarding estimates of the energy conservation achieved and the degree of state participation and achievement. (MHR)

672 **(DOE/CE—0050) Program activities: DOE State and Local Assistance Programs, 1983 report.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of State and Local Assistance Programs). Oct 1983. 29p. NTIS, PC A03/MF A01. Order Number DE84001885.

Progress achieved by the Department of Energy State and Local Assistance programs during FY 1983 and prior years is summarized. These programs provide financial and technical assistance to and through state and local governments, enabling them to plan and implement measures to improve the energy efficiency of industry, transportation, commercial establishments, public buildings and residences. The programs covered here are: State Energy Conservation, Energy Extension Service, Weatherization Assistance, Institutional Conservation, Energy-Related Inventions, Appropriate Technology Small Grants, and Grants Management and Technical Assistance. (MHR)

3201 Buildings

REFER ALSO TO CITATION(S) 376, 387, 388, 391, 393, 394, 409, 418, 597, 728, 1045

673 **(AD-A—130976/4) Development of a high efficiency compressor/expander for an air cycle air conditioning system. Final report.** Summers, R.L.; Smolinski, R.E. (Ecton Corp., Dayton, OH (USA)). 15 Nov 1982. 171p. NTIS, PC AMF A01.

This document presents the methods and procedures used and the results obtained in the design, fabrication, and testing of a rotary vane type compressor operated on air cycle thermodynamics. The history and results of the testing of a similar expander are summarized and the full report of that work is referenced. The machine design used was based on one patented by Ecton Corporation. The goal of the reported effort was to demonstrate the attainable efficiencies of these machines. Appropriate test rigs were assembled and the machines were tested at various operating conditions. The compressor testing did not achieve the full design speed because of time constraints but important data was obtained at 87% speed (3000 rpm). The maximum measured total efficiencies were 78% for the expander and 71% for the compressor. Various design improvements which may yield improved performance were identified and reported.

674 **(CONF-8310163—7) Insulation with low thermal conductivity.** Copeland, G.L.; McElroy, D.L.; Graves, R.S.; Weaver, F.J.; Fine, H.A.; Tong, T.W. (Oak Ridge National Lab., TN (USA); Kentucky Univ., Lexington (USA). Dept. of Metallurgical Engineering and Mechanical Engineering). 1983. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE84001963.

From 18. international thermal conductivity conference; Rapid City, SD, USA (3 Oct 1983).

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In an effort to identify candidate materials, the thermal conductivity (λ) was measured from 300 to 335 K for unevacuated and evacuated systems of angstrom and micron-size particles. A radial heat flow apparatus provided λ-values for unevacuated systems as a function of density, particle size, and composition. For nominally 100 A diameter particles in air the λ at 300 K shows a minimum near 10% solid of about 0.020 W/m.K, or 80% of λ of air. A simplified analysis was used to describe the dependence of heat transfer on particle systems characteristics and to suggest further tests. A large, unguarded longitudinal heat flow apparatus was used to measure λ of three sealed evacuated flat panels that contained compacted amorphous fumed silica particles less than 100 A diameter. Each panel was orginally evacuated to about 1 mm of Hg. The panel λ-values increase between 300 and 325 K, are in the range 0.008 to 0.016 W/m.K, and can be described by $a + bT^3$.

675 **(DOE/CE—0047) Federal ten-year buildings plan.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Buildings Energy R and D). Sep 1983. 61p. NTIS, PC A04/MF A01. Order Number DE84001636.

This federal 10-year buildings plan is required by Section 381 of the Energy Policy and Conservation Act (EPCA), as amended, which requires the President to the extent of his authority under other law, to implement a 10-year plan for energy conservation in federal buildings. This document, the federal 10-year buildings plan, states the goals and objectives of the Federal Buildings Program. It describes the characteristics of the federal building inventory, a strategy for achieving program goals, the responsibilities of participants, planning guidance, implementation activities, and provides a program status summary.

676 **(DOE/CE—0051) Final regulatory impact analysis: Commercial and Apartment Conservation Service Program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Buildings Energy R and D). Jul 1983. 61p. NTIS, PC A04/MF A01. Order Number DE84002675.

This final Regulatory Impact Analysis includes discussion of the various requirements of Executive Order 12291, possible alternatives to the proposed CACS Program, and the statutory requirements for and the likely consequences of the CACS regulations; statistical profiles of the number and energy use characteristics of buildings potentially covered by the CACS Program; descriptions of some existing apartment building and small commercial building audit programs being conducted by utilities; and a benefit/cost analysis of the CACS program.

677 **(DOE/CS/20524—3-Draft) Affordable manufactured housing through energy conservation: a guide to designing and constructing energy efficient manufactured homes. Data base for simplified energy analysis.** (Winter (Steven) Associates, Inc., New York (USA)). May 1983. Contract AC01-79CS20524. 180p. NTIS, PC A09/MF A01. Order Number DE84001741.

The tables in this document provide the data base for developing Slide Rules for estimating energy savings associated with select energy conservation options. Data is provided for two house types, single- and multi-section manufactured homes, in 44 locations. The values on each of the tables are delta heating and cooling energy savings expressed in millions of BTUs from the base value indicated. The selection of conservation options is intended to represent the range of insulation and window strategies likely to be incorporated in manufactured housing. For both types of conservation options a reference value is provided (indicated as a zero) for future use in designing a slide rule type presentation. The base case load is that load superimposed on the heating or cooling equipment when the home has the reference case characteristics. The building load for a home with different characteristics can be determined by adding the individual deltas (always negative values) for the selected characteristics to the base case load.

678 **(DOE/CS/60477—T1) Trainees' resource file: grants processing training events.** (Social Research Applications Corp., Washington, DC (USA)). [nd]. Contract AC01-79CS60477. 103p. NTIS, PC A06/MF A01. Order Number DE84001804.

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This Trainees Resource File (TRF) is to be used as a study tool by persons being trained to conduct regional grant applications reviews during the first cycle of activity in the Institutional Buildings technical assistance and energy conservation measures cost-sharing grant program. Each trainee will receive this TRF prior to training. It contains materials prepared by various offices, divisions, and branches within the Department of Energy. While each of the readings has had distribution in the past, they are assembled here for the convenience of the trainee.

679 **(DOE/R4/10102—T1) High-efficiency cooking utensil for use on electric stoves. Appropriate technology small grants program. Final report.** Fielder, M.V. (Fielder (Mary V.), Gainesville, FL (USA)). May 1981. Contract FG44-80R410102. 58p. NTIS, PC A04/MF A01. Order Number DE84000261.

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Design criteria were developed for an energy efficient pan. The criteria included: fabrication from a metal that not only is high in heat transfer, but that also has high heat retention; be shaped to surround and fit the standard burner element well; and have a well fitting lid. Such a pan was designed, and three prototypes were constructed. All three prototypes met the above criteria. The prototypes were tested by a consulting firm, and one of the prototypes performed more efficiently on every test than any of the tested commercial cookware.

680 **(DOE/R4/10106—T1) Home hot-water-heating system. Final performance report.** Skinner, F. (Skinner (Ferrell S.), Iuka, MS (USA)). 1981. Contract FG44-80R410106. 7p. NTIS, PC A02/MF A01. Order Number DE84000266.

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A hot water and space heating system is described which consists of an insulated water tank with a wood-burning fire box inside and appropriate plumbing. (LEW)

681 **(DOE/R4/10121—T1) Wood furnance cuts fuel bills and wastes.** (Saddlecraft, Inc., Cherokee, NC (USA)). 1982. Contract FG44-80R410121. 5p. NTIS, PC A02/MF A01. Order Number DE84000708.

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The use of a wood burning furnace instead of propane to heat the Saddlecraft manufacturing plant in Cherokee, North Carolina, is described. A chart shows gallons of propane usage in winter for five years. (MHR)

682 **(DOE/R4/10126—T1) Manufacture of thermal insulation with portable equipment.** Spring, S. (Spring (Samuel), Blairsville, GA (USA)). [nd]. Contract FG44-80R410126. 19p. NTIS, PC A02/MF A01. Order Number DE84000810.

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Experiments in manufacturing thermal insulation from clay and sawdust or woodchips are reported. The following are reported: agglomeration properties and plasticity of North Georgia clay, properties of the clay, ratios of clay and sawdust in the manufacture of the product, control of the size of bails, use of cement mixer, use of wood chips, the role of moisture and its removal, insulation properties, flammability, density, and the economics of on-site production. (MHR)

683 **(DOE/R4/10128—T1) Appalachian appropriate technology project exhibits at 1982 World's Fair. Final report.** (Fort Sanders Development Corp., Knoxville, TN (USA)). 1982. Contract FG44-80R410128. 22p. NTIS, PC A02/MF A01. Order Number DE84000268.

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The work of the Appalachian Appropriate Technology Project on seven turn-of-the-century houses for the 1982 World's Fair in Knoxville is reviewed. A work session called a Design-In to decide how to use the houses is described and correspondence related to the project is included. (MHR)

684 **(DOE/R4/10132—T1) UET's energy saving technologies.** (United Energy Technologies, St. Petersburg, FL (USA)). 1981. Contract FG44-80R410132. 11p. NTIS, PC A02/MF A01. Order Number DE84000741.

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Some energy savings data resulting from energy management of electrical water heating are given. (LEW)

685 **(DOE/R4/10139—T1) Community Integrated Energy Systems Project. Final report.** (Carolina Friends School, Inc., Durham, NC (USA)). 29 Dec 1982. Contract FG44-80R410139. 14p. NTIS, PC A02/MF A01. Order Number DE84000272.

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Fifty-five residential client were served directly and weatherization materials were provided for sixty-five more. Fifty-two residential and fifteen institutional/commercial audits were done, preparing detailed reports and specific recommendations. Eight water heaters and one attic were insulated and roof repairs were provided to enable another low-income client to receive weatherization. (MHR)

686 **(DOE/R4/10146—T1) Thermal-insulation panels for mobile homes. Final program progress report.** (Dixie Fiberglass Products, Inc., Winter Garden, FL (USA)). [nd]. Contract FG44-80R410146. 28p. NTIS, PC A03/MF A01. Order Number DE84000742.

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The manufacture and installation of the roof panels was accomplished by the Dixie Fiberglass Products (DFP) plant which is located in Winter Garden, Florida. Panels were removed and retained by DFP at the conclusion of the test sequence. Florida Solar Energy Center conducted the test necessary to investigate the effect of a fiberglass skin and polyurethane foam insulation roof panel installation on the cooling loss of a ten-foot wide mobile home structure. Temperature and heat-flow data with a 5000 Btu air conditioner installed were collected by FSEC starting on September 5, 1980. These data included inside and outside surface temperatures of ceiling, walls, and floor, room and ambient temperature and cumulative and instantaneous insolation.

687 **(DOE/R4/10150—T1) Use of thermography in the detection of heat loss from school buildings: a manual for school officials.** Cage, B.N.; Walls, M.; Wolfe, C. (Educational Planners and Evaluators, Oxford, MS (USA)). 1981. Contract FG44-80R410150. 40p. NTIS, PC A03/MF A01. Order Number DE84000386.

Approaches to the assessment of thermal efficiency of a building are described. Other topics discussed are: the effectiveness of various systems, the use of thermography, cost-effectiveness considerations, and the use of this technology in the public school setting. (MHR)

688 **(DOE/R4/10162—T1) Soil heat as an alternative source of energy for heat pumps in the regional setting of upper East Tennessee.** Peplies, R.W.; Close, D.M.; Morabarakeh, B. (East Tennessee State Univ., Johnson City (USA)). Jun 1982. Contract FG44-80R410162. 57p. NTIS, PC A04/MF A01. Order Number DE84000275.

The soils of Upper East Tennessee are studied for use as a heat exchanger. The experiment design and results are presented. The hydrology and theoretical background are described. (MHR)

689 **(DOE/R4/10211—T1) Rammed-earth construction. Final technical report.** (Miller (R.G.), Pineville, NC (USA)). 1981. Contract FG44-80R410211. 12p. NTIS, PC A02/MF A01. Order Number DE84000433.

Material on rammed earth houses 40 years old or more is reviewed. Experience in building such a house and the various devices and soil compositions used are described. (MHR)

690 **(DOE/R4/10220—T1) Daily-cycle energy system.** Jarriel, J.L. (Jarriel (Jack L.), Aiken, SC (USA)). Sep 1981. Contract FG44-80R410220. 31p. NTIS, PC A03. Order Number DE84000698.

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The Daily Cycle Energy System conserves electrical energy by producing ice efficiently during the cool nighttime hours. The

ice is subsequently used for comfort cooling during the hotter daytime hours. Thermodynamic and economic analyses of a standard air conditioning system and the proposed DCES indicate that both energy and monetary savings will result from installing DCES equipment in some regions. (LEW)

691 **(DOE/R4/10236—T1) Efficient wood-burning furnace for home.** (Hale (M.), Bone Cave, TN (USA)). [nd]. Contract FG44-80R410236. 3p. NTIS, PC A02/MF A01. Order Number DE84000279.

A wood-burning furnace for home heating and water heating was assembled and installed for testing. It was found to be inexpensive and efficient, resulting in decreased heating cost for the house in which it was installed. (LEW)

692 **(DOE/R4/10241—T1) Frog Hollow down-draft furnace. Final technical report.** Hillenbrand, S.J. (Hillenbrand (Stephen J.), Knoxville, TN (USA)). [nd]. Contract FG44-80R410241. 8p. NTIS, PC A02/MF A01. Order Number DE84000673.

The tested down draft furnace provided approximately one-third to one-half of the heating requirements for a 3000 square foot Victorian style house. No significant reduction in air pollutants was observed in the down draft mode compared to the up draft mode. The furnace was tested in a 1908 circa Victorian style house refitted with central heating. It was installed up stream of a standard gas furnace providing a hybrid heating arrangement.

693 **(DOE/R4/10242—T1) Waste-water heat-recovery unit. Final report.** Crichton, J.L. (Crichton (Joseph L.), Knoxville, TN (USA)). [nd]. Contract FG44-80R410242. 11p. NTIS, PC A02. Order Number DE84000669.

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After construction the Waste Water Heat Recovery Unit (WWHRU) was installed on February 21, 1981 in a single family dwelling with two adults and two children. The initial results were beyond expectation, but efficiency steadily declined. The initial results showed rises of 18° between ambient cold water temperature and preheated temperature, but these were for low demand uses such as shower. The results as appear on the Daily Usage Reports are inaccurate because I discovered the readings were taken at the initial start of the event (i.e. as bath started preheat temperature is same or close to reservoir temperature, but rapidly drops on high demand usage). As a result the WWHRU proves not to be practical.

694 **(DOE/R4/10250—T1) Fuel conservation through throttling. Final technical report.** Currens, V.C.; Edwards, R.G. (Edwards (R.G.), Lexington, KY (USA)). Dec 1981. Contract FG44-80R410250. 66p. NTIS, PC A04/MF A01. Order Number DE84000376.

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A study was conducted during the 1980 to 1981 heating season to investigate the hypothesis that reducing the gas flow to residential furnaces might result in more efficient operation. The residential gas-fired furnaces of the two investigators were instrumented to enable the accurate monitoring of gas usage, and throttling valves were installed to permit reducing the gas flow rate. During the winter heating season, different input gas flow rates were set on each furnace, and gas consumed, climatological data, and other pertinent data carefully recorded each day. The net result from the study revealed a 12.5% increase in efficiency when one furnace was operated at 73% rather than at the full gas flow rate, while a 5.4% increase in efficiency was demonstrated from the other furnace when operated at 71% rather than at the full input gas flow rate. This limited study, therefore, illustrated a 9% average increase in efficiency attributable to simply reducing the input gas flow rate by about 30%. As a consequence from this pilot study, the D.O.E. funded a follow-on study whereby the technique will be applied to 12 homes in the Lexington, Kentucky area during the 1981 to 1982 heating season to ascertain if similar increased efficiencies can be demonstrated.

695 **(DOE/R4/10253—T1-Pt.1) Prefabricated heat-exchanging fireplace. Final technical report.** Schleper, M.A. (Schleper (Michael A.), Villa Hills, KY (USA)). 15 Jun 1981. Contract FG44-80R410253. 87p. NTIS, PC A05/MF A01. Order Number DE84000770.

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A heat-exchanging fireplace was installed in a 2000 square foot home and the standard air distribution equipment was ducted directly to the forced-air heating system of the home. The standard air distribution equipment for the fireplace included two squirrel-cage blowers which were connected to a thermostat, allowing a choice of temperature ranges; and a snap disc thermostat was used to disconnect the blowers in order to avoid blowing cold air after the fire died out. Arranged in this manner, one is able to set the regular home thermostat a few degrees lower than the fireplace thermostat, and this will allow the regular heating system to turn on after the fire has gone out in the fireplace. Energy consumption in both the fireplace and the conventional heating system was monitored throughout a heating season and then compared with past heating seasons when only a conventional heating system was used.

696 **(DOE/R4/10258—T1) Waste-heat exchange system. Final technical report.** (Alcorn County Schools, Corinth, MS (USA)). [nd]. Contract FG44-80R410258. 4p. NTIS, PC A02/MF A01. Order Number DE84000413.

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The construction of a simple wind suction tunnel is described using one 4' x 8' sheet of interior plywood (1/4") paneling board painted white and installation of one small 110 volt barrel type fan to pull warm air from the ceiling of a classroom and forcing air across the otherwise cool floor area. Warmer air that collects near the ceiling (waste heat) can, therefore, be reused (exchanged) thus requiring less use of energy consumption by existing heating system.

697 **(DOE/R4/10292—T1) Earth-tempered building system.** Lowstuter, W.R. (Lowstuter (W. Robert), St. Petersburg, FL (USA)). [nd]. Contract FG44-80R410292. 30p. NTIS, PC A03/MF A01. Order Number DE84000326.

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The feasibility of using the ground and the ground water layer as a heat sink to help heat and cool a Florida home was investigated. Final measure of success is to be kilowatts of power used monthly over time compared with previous years. Aluminum pipes and aluminum bars were put into the ground and attached to the house concrete blocks and built into the block walls and floor during construction. Also the walls and addition roof were covered with a minimum of 4 inches of polyurethane insulation for a value of about R-30. The volume of the house was increased by 43% from 1400 sq ft to 2000 sq ft. The data show that the system worked better at the larger temperature differences found in the winter. No changes were made in the heat pump system.

698 **(DOE/R4/10298—T1) Heat-pump complement.** (Velso (J.), Tampa, FL (USA)). [nd]. Contract FG44-80R410298. 10p. NTIS, PC A02/MF A01. Order Number DE84000418.

A small, efficient water-cooled heat pump was installed to complement the existing heating and cooling system. Costs, installation details, and electrical bills are presented. (MHR)

699 **(DOE/R4/10301—T1) Design and construction of a storm window with increased thermal efficiency which opens to allow ventilation as needed. Final technical report, proposal number F375.** (Tyrrell (Frederick S.), Port Richey, FL (USA)). 1980. Contract FG44-80R410301. 79p. NTIS, PC A05/MF A01. Order Number DE84000401.

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The project as originally conceived and funded envisioned a conventional full - window - length storm sash mounted in the cement block window opening. Appropriate linkage would open the storm sash. This design proved to be a safety hazard and physically undesirable. The design of the storm window sash was revised. Individual storm frames were to be mounted on each awning sash. Mechanical interferences with the storm sash occurred when

a two inch air space was used. This was solved by reducing the air space to the optimum dimension of 3/4 inches. The sizes and configuration of the awning type windows were studied to aid in cost effective and efficient design of the storm frame. It was discovered that in all but the later (aluminum conserving) models, the window pane was recessed 3/4 inches. This serendipidous fact resulted in the design of a triple glazed window utilizing only one storm sash glazed on both sides. The resultant combination window and storm sash is estimated to give approximately R 3.9 to R 5.2 insulation value.

700 **(DOE/R4/10328—T1) Rock bin heat storage for wood furnace.** Dickert, P.M. (Dickert (Phillip M.), North Augusta, SC (USA)). [nd]. Contract FG44-80R410328. 13p. NTIS, PC A02. Order Number DE84000702.

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A rock storage bin was built to store and regulate heat from a wood burning furnace. The furnace was fired to keep a constant output of 140° during times of operation. The furnace output was routed to the house when heat was needed and other times into the rock storage bin. Once the furnace output dropped below 70° the house demand was provided from the stored heat until depleted. (LEW)

701 **(DOE/R4/10446—T1) Develop interior insulating window panels that are energy-saving, decorative, and easy to install. Final technical report.** Domning, B.A. Jr. (Domning (Benard A., Jr.), Mobile, AL (USA)). Jul 1982. Contract FG44-81R410446. 22p. NTIS, PC A02/MF A01. Order Number DE84000265.

An insulating sheathing board with an R value of 3.6 at 75°F for a 1/2″ thickness was selected as the panel material for this project. The material is manufactured in 4′ x 8′ sheets by Temple from low density polyurethane foam with an aluminum foil facing on both sides. The 1/2″ thick sheathing is readily available to consumers through building supply outlets. All panels were fabricated to a 1″ thickness by laminating two 1/2″ sheets together with solvent base contact cement. Standard 2″ wide aluminum colored air conditioning duct tape was used to cover all exposed foam material at the edges of the panels. Finishes were primarily wallpaper and exterior latex paint. Hinges were fabricated from the same duct tape used to finish the panel edges. All non-removable panels were fastened to the window areas with small tacks. A total of 22 panels were fabricated in varying configurations of the following types: removable panel, shutter-type panel, half-shutter panel, and bi-fold panel. The result of the project was covering 233 sq. ft. of window area (12% of the exterior wall area), of the grantee's home with decorative panels that provide energy loss protection five (5) times greater than storm windows for less cost.

702 **(DOE/R4/10459—T1) Field testing of an automated wood-combustion system and development of business plan for commercialization of production. Final report for period ending August 1, 1982.** (Integrated Energy Systems, Inc., Chapel Hill, NC (USA)). 24 May 1983. Contract FG44-81R410459. 47p. NTIS, PC A03/MF A01. Order Number DE84000428.

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A tunnel burner for burning wood chips has been installed and tested at a school building in Durham, NC. The test revealed many problems which did not exist while testing a prototype in laboratories. Controls were found to work reliably. A business plan was developed and is appended. (LEW)

703 **(DOE/R4/10486—T1) Device to reduce air-conditioning loads by use of waste heat for dehumidification. Final report.** McCallum, T.O.; Russell, L.D. (Mississippi State Univ., Mississippi State (USA)). Jun 1983. Contract FG44-81R410486. 135p. NTIS, PC A07/MF A01. Order Number DE84000317.

Work performed and results obtained during the development of a device to reduce air conditioning loads by use of waste heat from the air conditioner for dehumidification are summarized. The device uses a silica gel desiccant material to dehumidify the air, and the silica gel is regenerated in a rotating drum configuration by use of the waste heat normally rejected by a vapor compression air conditioner. A dehumidifer sized for residential application was designed, built, and tested. A summary of the design of the dehumidifier, the major problems encountered in the design process, a description of the dehumidifier device, and the results of the dehumidifier tests are presented. The tests showed that a dehumidifier could operate on the heat rejected by an air conditioner, and that it could produce a cooling effect.

704 **(DOE/R4/10491—T1) Construction and installation of low-cost energy-conservation devices on existing residential structures. Final report.** (Buckhorn Children's Center, KY (USA)). 1983. Contract FG44-81R410491. 31p. NTIS, PC A03/MF A01. Order Number DE84000429.

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Through the Neighborhood Housing Services, Incorporated of Charlotte, a series of hands-on workshops and a demonstration site was provided to enable residents of the Plaza-Midwood Neighborhood to build and install a variety of low-cost, durable, small scale, energy conservation systems. This experimental approach enabled homeowners to apply specific technologies to their own homes. These cost effective measures were designed to encourage both self reliance and the use of renewable resources. The weekend projects included protected entry, numerous moveable window insulation devices, solar air collector/greenhouse, window greenhouse and water storage tubes. The building used for retrofit was the office for the Neighborhood Housing Services (NHS), a nonprofit corporation formed to help revitalize residential structures and maintain the economic, racial, and social character of existing neighborhoods. The particular neighborhood involved was Plaza-Midwood and covers approximately a 2 square mile area. The neighborhood housing stock is of the 1910 to 1940 variety with the predominate architectual style being bungalow frame, having 1000 to 1900 square feet in area. The neighborhood is a racially integrated one, with about 70% of the residents being homeowners. An estimated 1700 housing units are in this area. The NHS office presently serves as a resource center for area residents who need loans and/or construction assistance. Providing a continuing educational program is a function of this organization. The Grant provided a significant contribution as a resource for energy conservation mined residents. A resource room displaying procedures and diagrams for the various projects in this proposal was established. Additional resource literature was provided and used by local residents.

705 **(DOE/R4/10504—T1) Solar greenhouse and warm room with a spiral piping system for hot water and a low-cost building-construction method. Final report.** Peckworth, R.H. (Peckworth (Ralph H.), Charlotte, NC (USA)). 1983. Contract FG44-81R410504. 15p. NTIS, PC A02/MF A01. Order Number DE84000382.

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This project involved the construction of two small buildings, each mounted on skids, so that, if desired, they could be moved to various sites to demonstrate the following energy proposals: the use of a combination greenhouse and warm room as an addition to an older house for an economical heating solution; the use of PB (polybutylene) black flexible pipe as a solar water heating collector housed in the above solar area; and the use of COST FREE BUILDING BLOCKS made from readily available recycled waste material, namely empty steel and tin cans, repacked in used corrugated cartons. These blocks, laid up into a wall, using glue instead of mortar, make an excellent core wall that can later be covered with protective surfacing, perhaps a rigid foam plastic surface.

706 **(LBL—16221) Component leakage areas in residential buildings.** Reinhold, C.; Sonderegger, R. (Lawrence Berkeley Lab., CA (USA)). Jul 1983. Contract AC03-76SF00098. 64p. (CONF-8309177—1). NTIS, PC A04/MF A01. Order Number DE84000478.

From 4. Air Infiltration Centre conference on air infiltration reduction in existing buildings; Elm, Switzerland (26 Sep 1983).

The published data on component air leakage are reviewed and, from them, a set of component leakage figures are compiled for use in estimating leakage areas and their distribution in buildings. These calculations of leakage areas based on component lea-

kages are compared with measurements of leakage areas in 36 houses in different locations in the United States. The model appears to predict leakage area accurately for the average of the 36 houses, while for individual houses the standard deviation is about 20%. In addition to describing the methods used o calculate building leakage areas based on component information, the assumptions and methods to convert other types of component leakage data to component leakage areas are discussed. Where several independent data exist for the same components (e.g., windows), the quantitative differences are discussed in terms of possible differences in construction practices. In addition to understanding the relative importance of each component, the methods and data presented can be used to estimate building leakage areas based simply on drawings.

707 **(ORNL/CON—103) Residential Conservation Service. Model Audit manual.** (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 192p. NTIS, PC E10/MF $9.00. Order Number DE84002376.

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The Model Audit is a free technical assistance resource for voluntary use by utilities. The manual contains procedures for customer interviews, residence inspections, and cost and saving calculations. Data forms, calculation aids, weather and other data, and a section on presenting results to the customer are included. This revision incorporates updates issued on the original February 1980 version: improved calculational procedures for cooling load, replacement air conditioners, solar domestic hot water, thermosiphon air panels, sunspaces, and new procedures for several state-added measures.

708 **(ORNL/Sub—79-24711/1) Highly efficient commercial pulse-combustion gas-fired water heater. Research and development report.** Lawton, E.A.; Irwin, L.; Lawler, A.; Bohanan, L.N. (Whittaker Corp., North Hollywood, CA (USA). Shock Hydrodynamics Div.). Dec 1982. Contract W-7405-ENG-26. 141p. NTIS, PC A07/MF A01. Order Number DE84002403.

A prototype of a gas-fired, pulse-combustion water heater for commercial applications has been developed. The prototype development program consisted of a market assessment, design specifications and testing procedures, and a fabrication and test program. The unit is an instantaneous model which has a gas input rate of 185,000 Btu/h and a thermal efficiency of 97%. The unit consists of air and gas decouplers, concentric gas and air flapper valves, neck distributor head, combustion chamber, four resonance tubes, exhaust decoupler, and a preheater tank with a secondary heat exchanger.

709 **(ORNL/TM—8891) Assessment of reflective insulations for residential and commercial applications.** Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 72p. NTIS, PC A04/MF A01. Order Number DE84002254.

A survey of available products, uses, and thermal resistance data for thermal insulations that use combinations of air gaps and reflective surfaces to form thermal barriers is presented. Reflective products like pipe insulation or high thermal resistance evacuated panels that are used exclusively in industrial applications are not included. A one-dimensional steady-state calculation has been developed to provide a way of discussing the R-values of refelctive assemblies and their sensitivity to properties like surface emissivity or positioning of foil surfaces in a cavity. The products considered are used in residential or commercial applications.

710 **(PB—83-239905) CO_2-controlled ventilation system: pilot study.** Soedergren, D.; Punttila, A. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 33p. NTIS, PC E04/MF E01.

Large savings in the cost of construction and operation could be made if ventilation were adapted to the prevailing need. Ventilation of empty rooms is a frequent extravagance. Amongst the most promising of present possibilities for indicating occupancy, and thus the ventilation need, is that of measuring the level of carbon dioxide. The project includes a test with equipment for CO2-control of the outdoor air-flow in an office building.

711 **High thermal capacitance multilayer thermal insulation.** Mahefkey, E.T. Jr. US Patent Application 6-501,944. 7 Jun 1983. 12p.

A high thermal capacitance multilayer thermal insulation structure is described, which is of particular utility for thermal protection against exposure to alternate high and low radiant heat flux levels, and which comprises a laminate of alternate metal foil or metallized plastic foil layers and layers of material which are characterized by phase change upon the absorption of heat, the foil layers providing high reflectance and reradiation of the heat flux, and the phase change layers providing for absorption and storage of heat during periods of high heat flux for reradiation during periods of low heat flux.

712 **Air conditioning system with evaporative cooling apparatus.** Zalesak, P.F. US Patent Application 6-493,461. 11 May 1983. 11p.

An air conditioning system is described which incorporates evaporative cooling apparatus adapted to sequentially pass compressed air from a compressor through a heat exchanger and expansion cooling turbine and into an enclosure. A condensate extractor is interposed downstream of the expansion cooling turbine and located above the heat exchanger. A nozzle is mounted to the heat exchanger and connected via a water conduit to the condensate extractor so that gravity delivers extracted condensate to the nozzle. The nozzle communicates via an air conduit with the compressor so that compressed air disperses the extracted condensate through the nozzle to impinge upon the heat exchanger thereby effectuating evaporative cooling.

713 **(NP-tr—3901780) Influence of the working mode of gas heat pumps on the control of gas flow.** Thun, K. Translated from *GWF, das Gas- und Wasserfach: Gas/Erdgas ;* **122**: No. 10/11, 478-481(1981). 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83901780.

The effect the working mode of gas heat pumps has on gas sales and gas flow control of a gas supply undertaking is examined. The heat consumption values of gas-fired compression and gas-fired absorption heat pump systems are estimated for different types of residences. The ratio of annual gas consumption to the maximum hourly load deteriorates in relation to heating by boiler. With electrically driven heat pumps the utilization structure is particularly poor. Therefore for the operation of heat pump equipment the tariff structure must be changed fundamentally in comparison with conventional equipment. Higher gas price, however, reduces the economy of heat pump systems for the operator.

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714 (DOE/EIA—0425, pp 175-203) **Highway fuel use: trends and factors.** Greene, D.L. (Oak Ridge National Lab., TN). Sep 1983. NTIS, PC A14/MF A01. (CONF-8308138—).

From Energy Information Administration symposium on petroleum supply information; Arlington, VA, USA (24 Aug 1983).

This paper presents an analysis of the factors responsible for the different trend between highway gasoline use and highway diesel fuel use of late. Significant factors are thought to be: changes in vehicle size and composition; vehicle usage; energy intensiveness; and fuel switching. The two different types of highway fuel use are treated in depth, independently, but the conclusion is reached that these trends show a great deal about how the market adjusts to changing conditions. 31 references, 11 figures, 7 tables.

715 **(DOE/R4/10315—T1) Vertical navigation device for jet aircraft. Final report.** Cheek, F.L. (Cheek (Frank L.), Suches, GA (USA)). [nd]. Contract FG44-80R410315. 3p. NTIS, PC A02/MF A01. Order Number DE84000790.

The Vertical Navigation device for jet aircraft was completed within the limits of the budget. The device was demonstrated to representatives of the FAA, DOE, Delta Airlines and Eastern Airlines on 15 Dec 1982 at Aviation Electronics in Chamblee, Georgia. The device performed as it was intended to do and the demonstra-

tion was well received by all. Eastern is involved with another energy management system at present and decided to wait until those tests are complete before undertaking any other system tests. At this time Delta remains undecided as to running a test program. The energy aspects of the V-NAV program are impressive. Proper guidance for airliners in the vertical plane could save at least 3% of the fuel burn. This amounts to about 50 gallons per flight hour on a Boeing 727 airplane. Based on the projected cost of the device, it would pay for itself about 10 times in one year if installed and properly utilized by a pilot. Simple mathematics reveals that millions of gallons of jet fuel could be saved if the device was used in all jet transport aircraft. There are no apparent reasons that the device would not work as planned. Pilot acceptance of another cockpit aid would be the only possible problem. This could be solved with proper training and implementation into the system.

716 **(DOT-I—83-5) Public transportation in the 1980's: responding to pressures of fiscal austerity. Final report.** Meyer, M.D.; Hemily, P.B. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Transportation Studies). Feb 1982. 82p. NTIS, PC A05/MF A01. Order Number DE84900185.

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A telephone survey of 30 transit general managers was used to determine the general response of transit agencies to fiscal pressures. A more detailed case study of the Greater Bridgeport Transit District provided greater detail on the response process in one agency, especially focussing on the identification and implementation of feasible options. The concept of a transit agency's operational environment was used to identify the key analysis variables that guided the survey and case study. In general, these variables could be classified into two major categories: (1) those relating to the degree of decisionmaking independence of the agency, and (2) those relating to the degree to which an agency is capable of responding to financial pressures.

717 **(N—8322033) Motorized two-wheelers.** Pachiaudi, G. (Direc. des Routes et de la Circulation Routiere); Gerin, F. (Organ. Natl. de Securite Routiere); Delsey, J. (Soc. d'Etudes et de Realisations Automobiles C.D.); Lambert, J. (Soc. d'Etudes et de Realisations Automobiles C.D.). (Institut de Recherche sur les Transports, Arcueil (France)). Sep 1982. 140p. (In several languages). NTIS, PC A07/MF A01.

Statistical data upon the vehicle ownership of motorized two-wheelers and their evolution during the last few years are given for the French domestic market and the French production of these business or leisure vehicles. After a review of the different types and categories of motorized two-wheelers and their regulations, the design characteristic of these vehicles and the currently used technology are described. Operating parameters, fuel consumption, and the safety aspect are addressed. Solutions are proposed in order to reduce the frequency and gravity of accidents. The difficult problem of the dynamic balance of motorized two-wheelers is covered.

718 **(N—8322440) Motor-fuels for road vehicles.** Delsey, J.; Lambert, J.; Frybourg, A. (Institut de Recherche sur les Transports, Arcueil (France)). Nov 1982. 65p. (MIXED). (REPT—24). NTIS, PC A04/MF A01.

The different motor fuels used by road vehicles (super, gasoline, diesel oil, liquefied petrol gas,...) are defined. The different entries of energy consumption associated with the use and the manufacturing of the vehicle, as well as road construction and road maintenance are studied. The different existing methods of refining petrol are reviewed, followed by a study of the different techniques designed to adjust the qualities of motor fuels to the needs of the vehicles. The energy cost of motor fuel manufacturing is also mentioned. The different problems raised by substitution motor fuels are reviewed (alcohol, synthetical motor fuels,...).

719 **(N—8323212) Annual Transportation Convention, volume 2. Session F: Energy and Transportation Engineering. Session G: Transport Planning.** (Council for Scientific and Industrial Research, Pretoria (South Africa)). 1982. 463p. (In several languages). (CONF-8208160—). NTIS, PC A20/MF A01.

From Annual transportation conference; Pretoria, South Africa (9 Aug 1982).

Issues regarding gasoline shortages, alternative fuels, and electric motor vehicles are discussed. Urban development and transportation planning methods are also a considered. For individual titles, see N83-23213 through N83-23220.

720 **(N—8323215) Prospects of motor vehicles as a means of transportation and of alternative drives.** Bader, C.F. (Daimler-Benz A.G., Stuttgart (Germany, F.R.)). 1982. 23p. (CONF-8208160—). NTIS, PC A20/MF A01.

From Annual transportation conference; Pretoria, South Africa (9 Aug 1982).

The predominance of motor vehicles as a means of transport is ascribable to the various advantages that such vehicles offer, including their use of liquid fuels, which makes them very versatile. It is necessary to investigate to what extent crude oil can be replaced with alternative fuels or drives as the means of supplying energy to motor vehicles. Alternative drives may consist of an electric energy supply on its own, or may combine two different driving or energy-supplying units in the form of a hybrid drive system. The various possible alternative drives for buses should meet the critica of freedom of operational choice, independent of crude oil and use of primary energy to varying extents. Except in the case of the trolley bus, freedom of operational choice and increased independence of crude oil are always accompanied by increased use of primary energy, and usually by higher operating costs. The higher costs are partly a result of higher vehicle purchasing costs and partly a result of the additional infrastructure required for operation.

721 **(N—8323216) New electric traction units of German design for city transport and suburban trains.** Scholtis, G. (Siemens A.G., Erlangen (Germany, F.R.)). 1982. 32p. (CONF-8208160—). NTIS, PC A20/MF A01.

From Annual transportation conference; Pretoria, South Africa (9 Aug 1982).

Four forms of city and suburban transportation are discussed namely multiple unit suburban trains, metros, light rail systems and tramways. Under each of these transportation forms the various users of the particular system both within West Germany and in other countries are listed. Data on the vehicle sizes and capacities in the various countries is presented. Some operating parameters of the various vehicles, such as speeds, acceleration and braking, are discussed. Technical solutions and developments as well as maintenance aspects, and comfort of the commuter are presented. The energy saved due to the use of modern electric technology is given some attention as well, and developments are highlighted. It is concluded that the various systems were developed over many decades, but that progress is being made in all the systems towards achieving more economical and efficient services.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 86, 89, 108, 179, 394, 1046

722 **(CONF-8310200—1) Shifts in product mix versus energy intensity as determinants of energy consumption in the manufacturing sector.** Samuels, G. Jr.; Vogt, D.P.; Evans, D.M. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). Sep 1983. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01. Order Number DE84001972.

From EPRI workshop; Palo Alto, CA, USA (26 Oct 1983).

The energy intensity (EI) changes that occurred in manufacturing industries between 1975 and 1980 are examined, and future energy requirements are projected on the basis of various assumptions about such changes in the future. For the 1975 to 1980 period, the aggregate EI of non-electric energy use declined by about 21% (4.6% per year), with 75% of the change attributed to efficiency improvements and/or process changes and the remainder attributed to changes in the product mix of output. For electricity use the aggregate EI declined about 9% (1.8% per year) with over 90% of the change attributed to efficiency improvements and/or process changes. The effect of efficiency improvements and product mix

changes on future manufacturing energy use was examined for eight cases - the combination of two EI scenarios with four alternative assumptions of industry-specific output growth rates. The two EI scenarios were: (1) 1980 EI values remain constant beyond 1980; and (2) trends in EI during the 1975 to 1980 period continue. The four economic growth cases considered were: (1) a continuation of the aggregate 1975 to 1980 growth rate of 3.96% with product mix held constant; (2) the historical trends in specific industries continued (product mix varies); (3) the Bureau of Industrial Economic projections, which also indicate product mix changes; and (4) the same as (3) except that petroleum refining, blast furnaces and steel mills, and primary aluminum decline at an annual rate of 3.5 to 4.0%. The growth rates in energy use to 1990 for these cases ranged from -1.31% to 3.96% per year for non-electric energy and from 1.62% to 3.96% per year for electricity. Preliminary results of the regional energy growth rates for two scenarios are also included.

723 **(CONF-8310202—1-Draft) ANFLOW process for biotreatment of wastewater.** Donaldson, T.L. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE84001970.

From Biotechnology fair; Knoxville, TN, USA (13 Oct 1983).

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The ANFLOW process has been proven to be an efficient, energy-conserving technology for treatment of municipal wastewater. A pilot plant treating 50,000 gallons per day has been operated successfully for 2 years. Effluent BOD and TSS concentrations have generally met the EPA discharge limits of < 30 mg/L each in mild weather. Additional polishing treatment may be needed in cold weather. Sludge production is about 25% of that in conventional biooxidation processes. Capital costs are projected to be comparable to (perhaps less than) costs for conventional biooxidation, and energy consumption is projected to be substantially less than for conventional biooxidation.

724 **(DOE/CS/40034—T3) Freeze crystallization technology for black liquor concentration. Second interim report.** (Concentration Specialists, Inc., Andover, MA (USA)). Jul 1983. Contract AC01-78CS40034. 84p. NTIS, PC A05/MF A01. Order Number DE84001110.

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The pulp and paper industry is one of the largest consumers of energy. Concentration of black liquor (the stream resulting from the chemical separation of wood fibers in the pulping operation) uses 25% of the purchased energy to produce pulp, an equivalent of 33 million barrels of oil in 1982. Here it is shown that freeze concentration, an emerging concentration technology, has the potential of reducing the energy consumption by at least 45%. This amounts to a cost savings of $5 to $15 per ton of pulp depending on the cost of energy, geographical location, and method of application.

725 **(DOE/CS/40179—T1) New irrigation systems design for improving irrigation efficiencies and enhancing energy conservation.** Lyle, W.M.; Bordovsky, J.P. (Texas Agricultural Experiment Station, Lubbock (USA)). 31 Mar 1981. Contract FG01-78CS40179. 82p. NTIS, PC A05/MF A01. Order Number DE83016439.

A new concept in irrigation system design, which has the potential of significant savings in both water and energy requirements, has been developed and evaluated. The system is characterized by and has been labeled a low energy precision application (LEPA) system, which rather than spraying water into the air at moderate to high pressures, distributes it directly to the furrow at very low pressure through drop tubes and orifice controlled emitters. This occurs as the system continuously moves through the field in a rectilinear fashion. The system is used in conjunction with micro-basin land preparation designed to optimize the utilization of rainfall. The combined system minimizes the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. Significant savings of both water and energy resources are indicated from results of the testing to date. Operating pressure of the LEPA system is projected to range from 4.5 to 22 psi depending on length of system and flow rate. Distribution uniformities of 95 to 96% are also projected. Application efficiencies above 98% should be consistently possible. A 10% increase in rainfall retention is reported herein. However, the basin tillage aspect of the method offers potential savings much higher than this. Energy savings of 0.024 quad per year were estimated with conversion of present irrigation methods to LEPA irrigation.

726 **(DOE/CS/40182—T1) Agricultural instrumentation system for optimal use of irrigation water. Final report, July 1, 1978-August 31, 1981.** Prossen, P.J. (Prossen Industries, Los Alamitos, CA (USA)). Sep 1981. Contract AC01-78CS40182. 108p. NTIS, PC A06/MF A01. Order Number DE84002354.

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The feasibility of an instrumentation system for irrigated agriculture was determined by evaluating the performance of two experimental installations. The goal is to develop a technology to optimize the use of agricultural water. (ACR)

727 **(DOE/CS/40520—T1) Efficiency of compressed-air systems. Final report.** (Varigas Research, Inc., Timonium, MD (USA)). 1983. Contract AC03-81CS40520. 30p. NTIS, PC A03/MF A01. Order Number DE84002599.

The program undertaken by this contract is intended to quantify the current state of knowledge in American industry concerning the energy efficient design and operation of industrial compressed air systems and system components. Since there is no standard reference for designers and operators of compressed air systems which provides guidelines for maximizing the energy efficiency of these systems, a major product of this contract was the preparation of a guidebook for this purpose.

728 **(DOE/R4/10079—T1) Improved poultry house.** (Harris (Thomas D.), Auburn, AL (USA)). [nd]. Contract FG44-80R410079. 17p. NTIS, PC A02/MF A01. Order Number DE84000762.

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The relationship of energy and poultry production was explored in three areas: methane production from litter, broiler house insulation, and broiler house HVAC systems. The findings show that while a methane plant would not be popular with individual American poultry producers; the pay back in fuel and fertilizer, if the plant was located in close proximinity to the processing plant, would be favorable. Broiler house insulation has been dramatically improved since the outset of this study. Presently, all new installations in the survey area are the Environmental houses which are fully insulated. HVAC systems have had to keep pace with the introduction of better insulation. The new Environmental houses HVAC systems are fully automated and operating on a positive atmosphere principal. Ammonia and other problems have been kept in check while reducing air changes per house from a high of 7 per hour to as little as 3 per hour.

729 **(DOE/R4/10151—T1) Cogeneration of electricity using wood waste as a replacement for fossil fuels. Final report.** (Cumberland Mfg. Co., Sparta, TN (USA)). [nd]. Contract FG44-80R410151. 5p. NTIS, PC A02/MF A01. Order Number DE84000387.

The experiences of a wood products company in their efforts to work out a cogeneration system using wood wastes are reviewed. Negotiations with the public utility and result of equipment search are described. (MHR)

730 **(DOE/R4/10230—T1) Automobile air-conditioning unit. Final report.** Schaetzle, W.J. (Schaetzle (W.J.) and Associates, Inc., Tuscaloosa, AL (USA)). Dec 1982. Contract FG44-80R410230. 59p. NTIS, PC A04/MF A01. Order Number DE84000760.

In this study the refrigerant in the automobile air-conditioner is compressed by thermal energy in a unique compression system rather than by work in a standard compressor. The compression uses an intermittent compression process with a solid absorbent. The vapor is absorbed by an absorbent at relatively low temperature and ejected as the absorbent temperature is raised. A set of one way valves limits flow to one direction. Major contributions are

heat transfer requirements, molecular sieve-refrigerant matching, minimizing non-producing mass, solving thermal fatigue and shock problems, and applying this to automobile air-conditioning. The performance study shows energy savings up to fifty percent are possible, depending on engine load. A twenty percent energy savings with the vehicle tested with the air-conditioner in operation is average. The study also showed that less fuel is used with the windows open than with the air-conditioner operating.

731 **(DOE/R4/10240—T1) Conversion of sawmill engine from propane to wood-gas fuel operation.** Tillman, A. (Tillman (Andrew), Huntsville, TN (USA)). [nd]. Contract FG44-80R410240. 12p. NTIS, PC A02/MF A01. Order Number DE84000672.

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The goal was to successfully convert a 500 C.I.D. V8 sawmill engine from propane to wood gas as a primary fuel. Primary fuel implies that although liquid fuels are available, wood gas would be used instead, because of economic advantage. It was soon evident that the existing engine, without major internal modification, could not supply the necessary horsepower on wood gas to power the mill at a reasonable production rate. The wood gas could be produced easily and rapidly, requiring not an unreasonable amount of service, but could not be made to run the mill above 40 to 50% capacity. This production rate of 400 bd ft/h is equivalent to $60.00/h while labor at $30.00 to 40.00/h; plus log cost of $30.00 to 40.00/h leaves the owner moonlighting to pay for his sawmilling hobby. The break even point is probably 700 to 800 bd ft/h.

732 **(DOE/R4/10251—T1) French intensive truck garden.** Edwards, T.D. (Edwards (Thomas D.), Butler, KY (USA)). [nd]. Contract FG44-80R410251. 13p. NTIS, PC A02/MF A01. Order Number DE84000377.

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The French Intensive approach to truck gardening has the potential to provide substantially higher yields and lower per acre costs than do conventional farming techniques. It was the intent of this grant to show that there is the potential to accomplish the gains that the French Intensive method has to offer. It is obvious that locally grown food can greatly reduce transportation energy costs but when there is the consideration of higher efficiencies there will also be energy cost reductions due to lower fertilizer and pesticide useage. As with any farming technique, there is a substantial time interval for complete soil recovery after there have been made substantial soil modifications. There were major crop improvements even though there was such a short time since the soil had been greatly disturbed. It was also the intent of this grant to accomplish two other major objectives: first, the garden was managed under organic techniques which meant that there were no chemical fertilizers or synthetic pesticides to be used. Second, the garden was constructed so that a handicapped person in a wheelchair could manage and have a higher degree of self sufficiency with the garden. As an overall result, I would say that the garden has taken the first step of success and each year should become better.

733 **(DOE/R4/10482—T1) Cord-wood gasification and gas combustion.** Payne, F.A. (Clemson Univ., SC (USA). Dept. of Agricultural Engineering). 5 Jan 1983. Contract FG44-81R410482. 30p. NTIS, PC A03/MF A01. Order Number DE84000695.

The purpose of this project was to demonstrate to farmers and potential manufacturing interests a cord wood combustion system for providing thermal energy for curing flue-cured tobacco. Two stage combustion technology which offers advantages of clean and efficient combustion and a modulatable output was utilized. In 1980 a 1.0 GJ/h cord wood gasifier-combustor was designed and tested. Two-staged combustion of cord wood up to a diameter of 15 cm was achieved with a net energy efficiency of 70 to 80%. Modulation of the system output was demonstrated and a clean exhaust verified. The major problems encountered were loading wood into the hot gasifier on a continuous basis and control of the unit when modulating.

734 **(EUR—8603-DE-EN) Gas-expansion motor with screw-type air compressor. Final report.** Fuehr, H.B. (Hermann Heye Glasfabrik, Obernkirchen (Germany, F.R.)). 1983. 87p. European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037.

The construction and measuring phases of the pilot project in the field of energy conservation, gas expansion motor for driving a screw-type compressor are presented. The results of the first commercial year of operation with a gas expansion unit are summarized.

735 **(IS—4833) Recovery of metals from coal ash: an annotated bibliography.** Burnet, G.; Murtha, M.J.; Dunker, J.W. (Ames Lab., IA (USA)). Jan 1983. Contract W-7405-ENG-82. 113p. NTIS, PC A06/MF A01. Order Number DE84002633.

The criteria upon which the citations were chosen for this review were: (1) the citation had to mention coal ash as one of the raw materials or potential raw materials; and (2) the citation had to be concerned with the recovery of metals, or of minerals from which metals could be produced. Not included, for example, were citations which covered the general topic of recovery of Al from non-bauxite sources or the recovery of metals from flue gas desulfurization sludge. Also citations were excluded which covered the use of coal ash as an additive to concrete, a raw material for cement manufacture, a source of synthetic aggregate, or generally related to construction. In addition to this primary search of the literature, an overall secondary search was conducted through the references cited in the English language papers obtained in the primary search. The citations obtained in this secondary search were again judged on the above criteria for inclusion in this review. A final list of 244 citations formed the bibliography. Annotations for these citations were prepared from the papers themselves, if possible, or from abstracts of the papers. A few pertinent citations were included where neither the paper nor an abstract was available. The bibliographic citations and annotations appear in Section 7.0 of this review. A cross-index of the bibliographic citations is given in Section 6.0.

736 **(ORAU/IEA—83-8(M)) Aggregate energy demand patterns in the manufacturing sector.** Reister, D.B. (Oak Ridge Associated Universities, Inc., TN (USA)). Aug 1983. Contract AC05-76OR00033. 67p. NTIS, PC A04/MF A01. Order Number DE84002635.

Energy demand by 13 US manufacturing industries is analyzed from 1958 to 1978, a period with two phases. From 1958 to 1969 the economy grew steadily, energy prices were constant, and energy demand increased with the economy. From 1970 to 1978 the economy suffered two recessions, energy prices increased sharply, and energy demand grew more slowly than the economy. In general, industrial energy demand is influenced by technological change, energy conservation, and industrial output. To separate these three influences, a simple econometric model is used in which the ratio of energy demand and industrial output is a function of energy price and time; energy conservation depends on energy price and technological change depends on time. In the analysis, energy demand is subdivided into demand for fuel and demand for electricity for two reasons - because the data was available and because fuel is fundamentally different from electricity. The results of the analysis are that the average value of the ratio of fuel and output has been declining about 2% per year while the average value of the ratio of electricity and output has been increasing about 1% per year. Energy conservation has been an important influence. However, the price elasticities have been fairly small. The range is 0.0 to -0.4 for the ratio of fuel and output and 0.0 to -0.5 for the ratio of electricity and output.

737 **(PB—83-239962) Technologies and management strategies for hazardous waste control. Volume 2. Working papers. Part D. Alternatives for reducing hazardous waste generation using end-product substitution.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1983. 341p. NTIS, PC A15/MF A01.

This volume contains papers written for OTA to assist in preparation of the report TECHNOLOGIES AND MANAGE-

MENT STRATEGIES FOR HAZARDOUS WASTE CONTROL. The contents include alternatives for reducing hazardous waste generation using end-product substitution.

738 **(PNL—4505) Preliminary overview of innovative industrial-materials processes.** Hane, G.J.; Hauser, S.G.; Blahnik, D.E.; Eakin, D.E.; Gurwell, W.E.; Williams, T.A.; Abarcar, R.; Szekely, J.; Ashton, W.B. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 154p. NTIS, PC A08/MF A01. Order Number DE84001548.

In evaluating the potential for industrial energy conservation, 45 candidate processes were identified. The chemical and the iron and steel industries presented the most well-developed candidates, whereas those processes identified in the pulp and paper and textiles industries were the most speculative. Examples of the candidate processes identified include direct steelmaking and ore-to-powder systems, which potentially require 30 to 40% less energy, respectively, than conventional steelmaking systems; membrane separations and freeze crystallization, which offer up to 90% reductions in energy use when compared with distillation; the cold processing of cement, which offers a 50% reduction in energy requirements; and the dry forming of paper, which offers a 25% reduction in the energy needed for papermaking. A review of all the industries revealed that the revolutionary alternatives often use similar concepts in avoiding current process inefficiencies. These concepts include using chemical, physical, or biological processes to replace thermally intensive processes; using specific forms of energy to minimize wasteful thermal diffusion; using chemical, biological, or ultrasonic processes to replace physical reduction; combining multiple processing steps into a single reactor; using a dry processing to eliminate energy needed for evaporation; and using sterilization or biotechnology to reduce the need for refrigeration.

739 **(TVA/ONR/WR—83/11) High density culture of white bass X striped bass fingerlings in raceways using power plant heated effluent.** Collins, C.M.; Burton, G.L.; Schweinforth, R.L. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jun 1983. 19p. NTIS, PC A02/MF A01. Order Number DE84900282.

White bass (Morone chrysops) X striped bass (M. saxatilis) hybrids weighing 1691/lb were initially stocked in five 24 ft^3 floating screen cages for 20 days. Hybrids averaging one inch in total length and 361 fish/lb were released in four 614 ft^3 concrete raceways. Two stocking densities, 2.6 and 5.1 fish/ft^3, were evaluated in the 94-day study using a flow rate of 300 gpm/raceway. Water temperatures averaged 79°F and water quality was adequate throughout the production period. Fish were hand fed to satiation daily. Columnaris and Aeromonas hydrophila caused the most serious disease problems. Gas supersaturation was suspect in high mortality levels during cage culture of hybrid bass fry. Cannibalism may have been responsible for unaccountable losses prior to raceway stocking and at harvest. The study yielded 5773 hybrids weighing 658 lb. The high density treatment showed greater weight gain, average weight, average length and percent survival as well as improved food conversion. Results suggest that higher stocking densities and periodic grading may increase production and suppress cannibalism. 10 references, 3 figures, 3 tables.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 299, 300, 729, 1176

740 **(ANL/CNSV—43) District heating and cooling: a 28-city assessment.** Meshenberg, M.J. (Argonne National Lab., IL (USA)). Aug 1983. Contract W-31-109-ENG-38. 70p. NTIS, PC A04/MF A01. Order Number DE84002652.

Findings of a project that assessed the potential for construction of district heating and cooling (DHC) systems in 28 US cities are presented. The project sought to determine whether DHC could promote local community and economic development. In the preliminary assessment, 17 of the cities identified up to 23 projects that could be built within three to five years. Most of these projects would rely on nonscarce heat sources such as refuse or geothermal energy, and to improve financial feasibility, the majority would cogenerate electricity along with heat. Many would use existing power plants or industrial boilers to hold down capital costs. Overall, the projects could generate as amany as 24,000 jobs and retain $165 million that otherwise could leave the communities, thereby helping to stabilize local economies.

741 **(ANL/CNSV-TM—120-Vol.1) Thermal systems for conversion of municipal solid waste. Volume I. An overview.** Hickman, H.L. Jr. (Governmental Refuse Collection and Disposal Association, Silver Spring, MD (USA)). May 1983. Contract W-31-109-ENG-38. 54p. NTIS, PC A04/MF A01. Order Number DE84002558.

Five thermal conversion technologies are covered: (1) large-scale mass burners, (2) small-scale modular mass burners, (3) dedicated refuse-derived-fuel combustors, (4) pyrolytic reactors, and (5) fluidized-bed combustors.

742 **(DOE/CS/24310—T1) Full-scale field demonstration of unheated anaerobic contact stabilization. Final report, April 1, 1980-June 30, 1982.** Sykes, R.M.; Fan, K.S. (Ohio State Univ. Research Foundation, Columbus (USA)). Jul 1983. Contract AC02-80CS24310. 346p. NTIS, PC A15/MF A01. Order Number DE84001121.

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A full scale field demonstration of unheated anaerobic digestion, including both solids recycle and solids nonrecycle processes, was conducted at the Jackson Pike Wastewater Treatment Plant at Columbus, Ohio. Two digesters (locally called Tanks 4E and 6E) at this facility were used for this purpose. In the experimental system, the operating temperature was reduced gradually from 91°F to 63°F. There were eight periods in the Recycle Phase and four periods in the Nonrecycle Phase. Gas production, solids destruction, volatile fatty acid variation, alkalinity, and pH were monitored in each period. In addition, grease, long-chain fatty acids, and foaming were intensively investigated at the last two periods, C and D, of the Nonrecycle Phase.

743 **(DOE/R4/10219—T1) Wastewater-treatment plant energy-conservation program.** (CH2M Hill, Columbia, SC (USA)). Mar 1983. Contract FG44-80R410219. 103p. NTIS, PC A06/MF A01. Order Number DE84000697.

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The City of Cayce, South Carolina received a grant to investigate the feasibility of producing ethanol from algal feedstock grown, under controlled conditions, utilizing the City's treated wastewater effluent. The City's objective was to produce ethanol to blend with gasoline to produce gasohol for use in City vehicles thus reducing gasoline consumption. The first project task was a review of the technical literature to determine the state-of-the-art with respect to ethanol production utilizing algae as a feedstock. The literature search, determined that while a limited amount of research has been completed on the production of algae from wastewater, ethanol has never been produced from algae on a commercial scale. It was determined that a wastewater system would not provide favorable conditions for the efficient propagation of the best algae species and that harvesting techniques are expensive and inefficient. In the Spring of 1981, the study objectives were modified and the emphasis placed on designing a demonstration project to verify potential energy conservation features of agricultural utilization of sludge. In addition, it was decided to evaluate application of other energy reduction alternatives at the wastewater treatment plant.

744 **(DOE/R4/10414—T1) Landfill gas project. Final report.** (Florence, City of, AL (USA)). [nd]. Contract FG44-81R410414. 5p. NTIS, PC A02/MF A01. Order Number DE84000756.

The methane gas recovered from the landfill is used for space heating and water heating for the Florence-Lauderdale Humane Shelter 600 feet from the well head. The project to date and future development are described briefly. (MHR)

745 **(DOE/R4/10422—T1) Waterboro wastewater-treatment plant. Energy audit report.** (Summit Engineering Co., Inc., Spartanburg, SC (USA)). Dec 1981. Contract FG44-81R410422. 56p. NTIS, PC A04/MF A01. Order Number DE84000692.

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The findings of the energy audit are summarized and the capital costs versus yearly energy savings for various proposed changes to the existing treatment units are tabulated. Detailed discussions of the audit are presented.

746 **(DOE/R4/10442—T1) Central airport energy systems using alternate energy sources.** (Talbert, Cox and Associates, Charlotte, NC (USA)). Jul 1982. Contract FG44-81R410442. 39p. NTIS, PC A03/MF A01. Order Number DE84000397.

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The purpose of this project was to develop the concept of a central airport energy system designed to supply energy for aircraft ground support and terminal complex utility systems using municipal waste as a fuel. The major task was to estimate the potential for reducing aircraft and terminal fuel consumption by the use of alternate renewable energy sources. Additional efforts included an assessment of indirect benefits of reducing airport atmospheric and noise pollution.

747 **(N—8323789) Study for heat recovery from waste water and utilization possibilities illustrated by using the example of the city of Lemgo. Final Report, Nov. 1981.** Gassen, M.; Hunke, D. (Scheven Ingenieure G.m.b.H., Duesseldorf (Germany, F.R.)). Dec 1982. 95p. (In several languages). (BMFT-FB-T—82-235; ISSN—0340-7608). NTIS, PC A05/MF A01.

Bundesministerium fuer Forschung und Technologie.

The amount of heat contained in municipal waste water and the possibilities of recovering it were investigated. The effects of heat removal on the waste water treatment efficiency was discussed. The basic condition for the conceived process is that the heat is directly removed, i.e., without special conditioning, and brought to an adequate temperature level for use in the heat supply system via the heat pumps. Various possibilities for the use of heat contained in waste water were studied. The savings of primary energy is considerable compared with conventional heating systems. Nevertheless, the feasibility study carried out shows no savings in yearly costs as compared with conventional heating systems.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 678

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 755, 756

748 **(DOE/R4/10449—T1) Dual-fuel carburetion systems. Final report.** Elledge, J. (Alternate Energy Associates, Inc., Jonesboro, GA (USA)). 1981. Contract FG44-81R410449. 39p. NTIS, PC A03/MF A01. Order Number DE84000795.

A carburetor and fuel delivery system with a method of remotely changing fuel delivery and metering so that an engine could operate solely and correctly on either of two fuels is described. The remote actuator is in the form of an electric switch on the dash of the vehicle, requiring no expertise in carburetion or mechanical fields to quickly switch operation from one fuel to another.

749 **(N—8322594) Ignition technique for conventional motors by high energy spark.** Couto, H.D.S. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Feb 1983. 66p. (MIXED). (INPE—2645-TDL/116). NTIS, PC A04/MF A01.

The design, construction, use and testing of a capacitive constant high energy output electronic ignition which is associated with variable gap spark plugs is discussed. Its use was studied in a VW 1500 engine and results are presented in graphs of power vs air fuel ratio. The advantages ove the conventional system for lean mixture limit extension, the improvement of fuel burning conditions and the satisfactory burning of low grade fuels are discussed.

750 **(UCRL—89861) Chemical kinetics modeling of engine knock: preliminary results.** Pitz, W.J.; Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA)). 27 Sep 1983. Contract W-7405-ENG-48. 39p. (CONF-8310201—1). NTIS, PC A03/MF A01. Order Number DE84001236.

From Combustion Institute fall meeting of the western states section; Los Angeles, CA, USA (17 Oct 1983).

A theoretical model, including a detailed kinetic mechanism for propane oxidation, is used to examine the ignition of propane-air mixtures under conditions of pressure and temperature encountered in knocking engines. Purely kinetic calculations are used to evaluate relative time scales for the fuel-air ignition process, varying the initial pressure, temperature, and fuel-air equivalence ratio. A one dimensional model is then used to examine the combined effects of flame propagation, homogeneous ignition, and wall heat transfer on the autoignition of these mixtures. For the temperatures and pressures of concern in this study, it is found that the reaction mechanism is controlled by reactions of the hydroperoxyl radical, in contrast with similar mechanisms at higher temperatures and lower pressures. The time scales computed indicate that, in agreement with experimental evidence, propane-air ignition delay times are slightly longer than the relevant residence times in the end gases of a practical engine and that propane-air mixtures will therefore be quite resistant to knock. Extensions of the kinetic model to larger hydrocarbon fuel molecules which are more likely to knock, and to lower temperatures are discussed.

3302 External Combustion Engines

751 **(ORNL/CON—119) Stirling engine patents: international patent inventory.** Newman, B.K. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 181p. NTIS, PC A09/MF A01. Order Number DE84002378.

One hundred seventy-five years (1817-1982) of research and development (R and D) in Stirling-cycle engines is represented in this international inventory of patent applications. The following lists are included: assignor, assignee, patent numbers, US patent classification, and international patent classification. (MHR)

3303 Electric-powered Systems

752 **(DOE/R4/10235—T1) Long-distance electric vehicle. Final project report.** Bates, A. (Farm, Summertown, TN (USA)). 1 May 1982. Contract FG44-80R410235. 31p. NTIS, PC A03/MF A01. Order Number DE84000271.

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A standard, light automobile was converted to series hybrid electric propulsion. The vehicle was capable of using a variety of fuels with a substantial increase in fuel economy for the conventional fuels. Low cost, low technology, and ease of conversion were stressed in the design approach. After completion and testing of the first prototype, substantial modifications were made to the design, and experiments were conducted to examine alternative designs. The prototype vehicle is now undergoing additional modification as part of a continuing research and development program.

753 **(DOE/R4/10432—T1) Maximum-efficiency dc-motor project for electric vehicles. Final report.** Wolfe, S.; Wellborn, J. (Wolfe (Steve), Atlanta, GA (USA); Wellborn (John), Atlanta, GA (USA)). 31 Dec 1982. Contract FG44-81R410432. 18p. NTIS, PC A02/MF A01. Order Number DE84000791.

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Innovations to the operation of the typical direct current motor were made and included: an electronic circuit to generate a low-level voltage circulation, an interface circuit capable of an 800% voltage amplification and a 3000% current amplification, and a specially modified motor containing three additional brushes. The efficiency of the motor is maximized by an electronic circuit that aritificially rotates the magnetic field around the armature at low RPM so that the motor is running at near peak efficiency virtually all the time. (LEW)

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 819

3307 Emission Control

754 **(PB—83-241620) Low mileage catalyst evaluation with a methanol-fueled Rabbit - interim report. Technical report.** Wagner, R.D.; Landman, L.C. (Environmental Protection Agency, Ann Arbor, MI (USA)). May 1983. 170p. NTIS, PC A08/MF A01.

This report summarizes a test program which was designed to evaluate various exhaust catalysts at low mileage on a pure methanol-fueled Volkswagen Rabbit automobile. Hydrocarbons, carbon monoxide, nitrogen oxides and formaldehyde emissions were measured to identify which catalysts are the best candidates for durability testing in a later program. Catalysts formulations that are eventually selected for durability testing should cost no more, and preferably less, than the original catalyst on the vehicle. In addition, all catalysts should provide the capability to meet the Federal Exhaust Emission Standards for hydrocarbon (HC), carbon monoxide (CO) and nitrogen oxide (NOx).

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 309, 752

755 **(DOE/CS/51212—1-Vol.3-App.) Experimental hydrogen-fueled automotive engine design data-base project. Volume 3. Appendices.** Swain, M.R.; Adt, R.R. Jr.; Pappas, J.M. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering; Hawthorne Research and Testing, Inc., Miami, FL (USA)). May 1983. Contract AC03-77CS51212. 251p. NTIS, PC A12/MF A01. Order Number DE83017362.

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The following appendices are presented: maximum power estimates for hydrogen-fueled engine configurations; single-cylinder Toyota engine construction; thermocouple installation; construction of lithium-filled valves; originally-proposed EGR quantification scheme; certificates of instrument calibration; data-reduction computer program and experimental results; exhaust gas temperature determination for the pre IVC engines; calculation of excess hydrogen in the exhaust and H_2 utilization coefficient; exhaust valve thermal characteristics; steady-state diffusion (SWIRL) model; Bishop/Taylor ITE from BTE computer program and results; and NO/sub x/ emissions and fuel economy for hydrogen-fueled vehicles operated over driving cycles.

756 **(DOE/R4/10265—T1) Vegetable-oil test.** Suber, H. (Suber (Hollis), Thomasville, GA (USA)). [nd]. Contract FG44-80R410265. 23p. NTIS, PC A02/MF A01. Order Number DE84000782.

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A diesel engine was tested using soy oil as fuel. Tests were run using 20%, 50% 75%, and 100% soy oil combined with diesel fuel. Performance dropped somewhat at 75 and 100% soy oil. After media coverage, used soy oil was difficult to obtain. Other problems mentioned are increased carbon buildup, changes in crankcase oil, and odor. (MHR)

757 **(DOE/R4/10406—T1) Gasogen for automobile use. Final report.** Pritchard, C.L. (Pritchard (C. Lewis), Crossville, TN (USA)). 17 Jun 1983. Contract FG44-81R410406. 19p. NTIS, PC A02/MF A01. Order Number DE84000712.

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This project was originally intended to show how wood scrap may be recycled as a gasoline substitute for use with an automobile. A set of blueprints was obtained from Nunnikhoven Industries of Oakville, Iowa for the basic gasogen design. It was proposed that the unit be mounted on a small trailer which would be pulled by the vehicle using the woodgas. A large circular saw driven by PTO from a rear wheel of the vehicle was envisioned for processing sawmill slabs into small pieces suitable for use in the woodgas generator. A makeshift solar kiln for wood drying was also proposed. Records of all expenditures involved were to be kept for the purpose of determining the economic viability of such a project. Activities necessary for implementing these plans may be divided into four general categories. The following details are taken from field notes relating to: (1) purchase of materials, (2) construction of gasogen and saw, (3) transport, processing and storage of wood scrap, (4) record keeping and correlation.

758 **(DOE/R4/10470—T1) Improved wood-gas ignition.** Shipman, G.R.; Eoff, K.M. (Geo-Centers, Inc., Gainesville, FL (USA); Florida Univ., Gainesville (USA)). Sep 1982. Contract FG44-81R410470. 31p. NTIS, PC A03/MF A01. Order Number DE84000324.

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Wood gas burns more slowly in an internal combustion engine than gasoline does, requiring much greater spark advance and consequent loss of power. This factor limits the use of wood gas as a replacement for gasoline. This research examined plasma jet spark plugs, multiple discharge sparks, extended duration sparks and hydride fueled plasma plugs to see if any of these devices would improve the ignition of wood gas fueled engines. These devices have all been developed for burning very lean gasoline/air mixtures in which similar slow burning also results in power loss. The actual comparison was made by taking high speed Schlieren photographs of the burning flame front, providing thereby a measurement of relative flame velocities.

759 **(LA-UR—83-3028) Alternative gaseous-fuels safety assessment.** Krupka, M.C.; Peaslee, A.T. Jr.; Laquer, H.L. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 12p. (CONF-831205—2). NTIS, PC A02/MF A01. Order Number DE84001735.

From 6. Miami international conference on alternative energy sources; Miami Beach, FL, USA (12 Dec 1983).

A relative safety assessment of alternative gaseous and reference liquid fuels utilized for light automotive transportation in the public sector was completed. The specific fuels considered were compressed natural gas (CNG), liquefied natural gas (LNG), liquefied petroleum gas (LPG), and the liquid fuels, gasoline and diesel. The assessment methodology describes and develops the relative hazards of these fuels from an integrated generic physicochemical property and accident scenario point of view. A technique involving a method of eliciting expert judgment combined with a comparative scoring methodology was applied in establishing fuel relative safety rankings. Limitations of this type of assessment are discussed. Selected accident scenarios included fuel leakage in both residential and public garages; fueling line rupture at a refueling station in the presence of user vehicles or delivery vehicles; and vehicle collisions under rural, urban, and vehicular tunnel conditions. Overall, the results obtained demonstrate dependency upon the specific application or scenario. Gaseous fuels have increased relative risks in certain situations and are relatively safe in others. The results suggest that alternative gaseous fuels are not disqualified for public usage. The assessment also provides rationale for the development of selected safe handling criteria and recommendations.

36 MATERIALS

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 55, 147, 272, 272, 296, 482, 990, 992, 993, 1020, 1148, 1607, 1673, 1674, 1682

760 **(BNL-NUREG—33696) Stress corrosion of ASTM Grade-2 and Grade-12 titanium in simulated rock salt brines at 83°C.** Jain, H.; Ahn, T.M.; Soo, P. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 12p. (CONF-8310205—1). NTIS, PC A02/MF A01. Order Number DE84001212.

From TMS-AIME fall meeting; Philadelphia, PA, USA (2 Oct 1983).

Slow-strain-rate tests have been conducted on Grade-2 and Grade-12 titanium in simulated rock salt brines at 83°C. Although neither metal shows stress corrosion cracking, total elongation and reduction in area show some decrease. Optical and SEM results are discussed to elucidate the fracture mechanism.

761 **(CONF-821049—25) Effects of pulsed dual-ion irradiation on phase transformations and microstructure in Ti-modified austenitic alloy.** Lee, E.H.; Packan, N.H.; Mansur, L.K. (Oak Ridge National Lab., TN (USA)). 5 Jan 1983. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01. Order Number DE84001985.

From TMS/AIME fall meeting(Radiation damage analysis for fusion reactors); St. Louis, MO, USA (24 Oct 1982).

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The influence of pulsed 4 MeV Ni ion bombardment, with and without simultaneous helium injection, has been explored in a low swelling, Ti-modified austenitic stainless steel. Irradiations were carried out to 70 dpa at 950°K; the pulsing frequencies were either 60 s on/off or 1 s on/off. Compared to continuous irradiation, pulsing caused a decrease in the interstitial loop diameter at 1 dpa, although at higher doses the overall dislocation density was not affected. Pulsing and helium both promoted the stability of MC precipitates and retarded the subsequent G phase formation; in some cases G-phase was suppressed and eta phase formed instead. Small bubble-like cavities were observed to grow into large voids after steady dual beam irradiation to 70 dpa. However, this conversion was suppressed by pulse irradiation to 70 dpa and furthermore the sizes of the small cavities were somewhat reduced. The results are explained in terms of current mechanistic understanding of mean point defect kinetics and the evolution of microstructure and microcomposition during irradiation with superimposed annealing periods.

762 **(CONF-821049—26) Helium bubble formation in Cu, Ni and Cu-Ni alloys.** Zinkle, S.J.; Dodd, R.A.; Kulcinski, G.L.; Farrell, K. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Oct 1982. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01. Order Number DE84001993.

From TMS/AIME fall meeting(Radiation damage analysis for fusion reactors); St. Louis, MO, USA (24 Oct 1982).

Copper, nickel, and Cu-Ni alloys have been irradiated with 200 to 400 keV ^{3}He ions at a constant homologous temperature of T/T/sub m/ = 0.65. The samples have been analyzed by TEM to compare helium bubble size and density. Visible bubbles were observed in all samples. The pure copper and the Cu-Ni alloys were found to contain similar bubble densities and sizes after irradiation. The pure nickel samples contained helium bubbles of smaller size and higher density as compared to the alloys.

763 **(CONF-831086—6) In-situ photoacoustic spectrometry for corrosion studies.** Vallet, C.E.; Brown, G.M. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE84001994.

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

These preliminary experiments showed that detectable acoustic signals can be obtained with an illumination intensity of the electrode which does not produce a significant photoelectrochemical effect. We therefore are confident that in-situ photoacoustic spectroscopy coupled with electrochemical measurements will bring new insights into the mechanism of formation and breakdown of passive oxide films, with consequent implications for localized corrosion.

764 **(CONF-8106317—1) Progress with simple binary alloy solidification problems.** Wilson, D.G.; Solomon, A.D.; Alexiades, V. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; Tennessee Univ., Knoxville (USA)). 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE83015517.

From Symposium on free boundary problems; Montecatini, Italy (18 Jun 1981).

We give a preliminary report of our studies on binary alloy solidification. In what follows we state the mathematical problem, which we assume represents the solidification of a simple binary alloy; we give a very brief introduction to two component phase diagrams, whose relations we assume hold at the solidification front; we describe our phlogiston formulation of the problem, which is derived by analogy with the enthalpy method for simpler problems; we describe the finite difference scheme, with which we computer the various constituents of our phlogiston formulation; and finally we relate our computational experience with the model so far.

765 **(CONF-8310163—5) Transport properties of polycrystalline Ni_3Al.** Williams, R.K.; Weaver, F.J.; Graves, R.S. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE84001969.

From 18. international thermal conductivity conference; Rapid City, SD, USA (3 Oct 1983).

The room-temperature electrical and thermal conductivities of annealed high purity samples coantaining 74 to 76 at.% Ni are presented and compared to theoretical predictions. Residual (4.2°K) electrical resistivity data are also employed in the analysis and these results show a pronounced minimum at the stoichiometric composition. The data show that the thermal conductivity of this compound is quite sensitive to stoichiometry and, at room temperaure, has a maximum value at about 74.8 at.% Ni. Calculated and experimentally derived phonon thermal conductivity values agree well, and indicate that this carrier is responsible for about 25% of the room temperature thermal conductivity. The electronic Lorenz function is essentially equal to the Sommerfeld value.

766 **(CONF-8310203—1) Solidification and phase stability in austenitic stainless steels.** Cunningham, J.E. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01. Order Number DE84001937.

From DOE materials directors meeting; Los Alamos, NM, USA (19 Oct 1983).

The weldability of austenitic stainless steel continues to be of great interest. Recent work by Stan David and John Vitek give new insights to the understanding of solidification and phase stability in this class of materials. Their initial thrust centered on the use of higher rates of solidification, such as encountered in laser welding, and characterization of the resulting microstructures. More recently, they investigated that formation of sigma phase, especially the role of sigma phase in degrading material performance under load in service. This report highlights the results of their work.

767 **(DOE/ER/03459—18) Fatigue of niobium at elevated temperatures.** Stoloff, N.S.; Xiao, P.; Choudhury, R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 1 Jun 1983. Contract AC02-76ER03459. 35p. (CONF-8306138—1). NTIS, PC A03/MF A01. Order Number DE84001373.

From Fatigue and corrosion fatigue meeting; Montreal, Canada (1 Jun 1983).

High cycle and low cycle fatigue behavior of unalloyed niobium has been studied between room temperature and 800°C. High cycle lives decrease monotonically in vacuum with temperature to 800°C. However, low cycle fatigue lives in argon increase with temperature between 450 and 650°C. Frequency effects on LCF

are shown to be small in this range. Hold times imposed at peak loads also increases fatigue lives as well as the number of cycles to crack initiation in this temperature range. Fractographic examination revealed a transition from striated to dimpled fracture surfaces with increasing temperature for HCF specimens. LCF specimens, on the other hand, display large striations at 450 and 550 and extensive slip at 650°C. Impurities in argon used for LCF tests appear to be responsible for extensive surface cracking. The results are compared to those in the literature for other bcc refractory metals and alloys. 18 figures.

768 **(DOE/ER/10107—21) Structures and properties of rapidly solidified 9Cr-1Mo steel.** Megusar, J.; Lavernia, E.; Domalavage, P.; Harling, O.K.; Grant, N.J. (Massachusetts Inst. of Tech., Cambridge (USA)). 1983. Contract AC02-78ER10107. 6p. (CONF-830942—49). NTIS, PC A02/MF A01. Order Number DE84001276.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

Irradiation-induced shifts of the DBTT and possible hydrogen embrittlement of ferritic steels are currently considered major problems for CTR applications. Rapid solidification and in particular liquid dynamic compaction (LDC) has been studied in developing 9Cr-1Mo steel as a candidate first wall material. Structural refinements such as reduction of segregation, fine grain size and fine size of second phase particles are retained in this process and this will have a favorable effect on fracture properties. LCD has also the potential of preparing first wall components directly from the melt and this would have an economic advantage over conventional ingot technology.

769 **(DOE/ER/10870—142) EXAFS studies of the metallic glass $La_{80}Ga_{20}$.** Baxter, D.V.; Williams, A.; Johnson, W.L. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Jul 1983. Contract AT03-81ER10870. 12p. NTIS, PC A02/MF A01. Order Number DE84002022.

Ga-edge EXAFS experiments have been performed on the metallic glass $La_{80}Ga_{20}$. The results obtained are able to discriminate between a number of different models for the pair distribution function of atoms around the Ga, and the model which best fits the data provides coordination numbers and distances which are in agreement with earlier diffraction experiments. We find, however, that the two techniques give significantly different results for the degree of topological disorder in the first La coordination shell about the Ga atoms.

770 **(DOE/RL/10308—1) Hard-facing with electro-spark deposition. Final report.** Kees, K.P. (Washington State Univ., Pullman (USA). Coll. of Engineering). 1983. Contract AT06-81RL10308. 90p. NTIS, PC A05/MF A01. Order Number DE84001502.

Thesis.

A common method to improve wear resistance of metals in rubbing contact is to increase their surface hardness. Electro-Spark Deposition is a process which uses capacitive discharge pulses of high current passing through a hard carbide electrode in contact with and scanning the metal surface to be hardened. The result is a thin, hard, adherent coating of carbide deposited with a minimum of heat influence on the substrate and a significant increase in wear life of the coated metal. Electro-Spark Deposition is similar to a micro-welding process. It is a simple, portable and inexpensive coating method, which has great potential for commercial utilization. This thesis is an in depth study of the parameters associated with the ESD process and the wear resistance of the coatings.

771 **(EUR—7446-FR/DE) Response to hydrogen of the most important European steels used for transport and storage containers of gaseous hydrogen.** (Commission of the European Communities, Luxembourg). 1981. vp. (In French and German). Available from Commission of the European Communities, Luxembourg.

For this study we have used as test pieces imbedded disks deformed under gas pressure. Most tests have been carried out by dynamic rupture technique (deformation until rupture), other by delayed rupture technique (deformation until pressure below the dynamic rupture pressure, then wait until the rupture at static pressure). Some exploratory permeation and symmetrical plastic fatigue tests have also been carried out with the same type of test-piece (disk). Selected materials for our study are quenched and tempered steel grades 35 CD4, 30 CD10, 34 CrMo4, 28 Mn6 and 20 CND10, with two different states of heat treatment for the three first grades. Main results have been obtained by dynamic rupture tests; we have defined different criterions which have allowed us to compare the hydrogen behaviour of different steels; it appears that for a given steel, hydrogen embrittlement decreases : when tempering temperature increases (for a fixed quenching) and when hydrogen pollution (oxygen or water vapor) increases. Moreover these tests put in evidence that the empiric limit of 950 MPa for the tensile strength of hydrogen vessels steels, is more severe for 35 CD4 steel than for 30 CD10 steels. Finally it seems necessary to carry on this study in developping new fatigue tests and in conducting tests with check materials (good or bad) to clearly and logically define the different materials limit of utilization.

772 **(HEDL-SA—2907-FP) Use of subsized specimens for evaluating the fracture toughness of irradiated materials.** Huang, F.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76FF02170. 26p. (CONF-8309170—2). NTIS, PC A03/MF A01. Order Number DE84001500.

From Symposium on the use of nonstandard subsized specimens for irradiated testing; Albuquerque, NM, USA (23 Sep 1983).

The effects of specimen size, temperature and irradiation on fracture toughness were studied in unirradiated compact tension specimens of alloy A286 and HT-9 and irradiated specimens of 20 percent cold worked Type 316 stainless steel. Techniques for specimen preparation and test procedures were developed. Fracture toughness tests on these precracked specimens were conducted at various temperatures and test results were analyzed using the multiple specimen R-curve method. Due to irradiation hardening and postirradiation toughness degradation, sufficient constraint existed in thin irradiated specimens to permit the application of the J-integral approach. Analysis showed the absence of a significant size effect and that the size requirements for a valid J/sub 1c/ test were satisfied, indicating that small specimens may be used for post-irradiation fracture toughness testing. Results are discussed in terms of size criteria for valid J/sub 1c/ determination and conditions for J-controlled crack growth.

773 **(IKE—6-144) Accounting for the neutron spectrum in predicting the embrittlement of reactor vessel steels.** Al-Malah, K. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Mar 1983. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE83751343.

In this paper formulations are established for improving the correlation between the variation of characteristic data for pressure vessel steels and the damage-causing neutron exposure. They aim at accounting for the influence of the neutron spectrum and eliminating in a double respect uncertainties in the evaluation of the radiation damage: By reduction of the scattering band of the measured characteristic data and by improvement of the extrapolation of measured values in the accelerated irradiation specimen to the pressure vessel wall. For this purpose an exact determination is made of the neutron spectrum in the irradiation facilities for material specimens and in the pressure vessel wall. A suitable damage function is introduced to account for the interaction between the material and neutrons of different energies. For the evaluation of the neutron spectrum one- and two-dimensional transport calculations are performed. For damage functions the cross-section for the formation of atom displacements and the cross-section for the formation of movable vacancies were chosen. By multiplication of the neutron spectrum by the damage functions new exposure parameters are obtained by means of which measured, radiation-induced variations of the characteristic data, as e.g. the increase of the transition temperature for brittle fracture, were correlated.

774 **(ITEF—110(1982)) Cascades of atom collisions in metals.** Babaev, V.P.; Bobkov, A.F.; Zabolotnyj, V.T.; Ivanov, L.I.; Makhlin, N.A.; Suvorov, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1982. 39p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83704264.

Paper copy only, copy does not permit microfiche production4 refs.; 11 figs.

The experimental results are presented of autoionmicroscopy and electron-microscopy (with a transmission microscope) of radiation damages induced in tungsten by cascades of atomic collisions at energies ranging from 1 to 1000 keV. The data obtained are compared to the experimental results published elsewhere. The applicability of various theoretical models of radiation damages induced in metals by cascades of atomic collisions have been checked. A method has been devised for predicting the number and distribution of defects at various energies of initially displaced atoms and different temperatures of irradiation. The results of study may be used for the estimation of radiation resistance of structural materials intended for thermonuclear devices or nuclear power plants, a well as for the determination of material quality following ion implantation.

775 **(JAERI-M—82-032) Estimation of long term creep rupture strength of Hastelloy XR in HTGR helium environment.** Tamura, M.; Ogawa, Y.; Kurata, Y.; Kondo, T. (Japan Atomic Energy Research Inst., Tokyo). Apr 1982. 19p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703707.

Using special type specimens, which contained multiple diameters with step within the gauge portion in one piece, creep rupture and the associated surface phenomena were examined with special emphasis placed on the effect of oxidation and carburization on the creep and rupture properties. Based on the results obtained, creep rupture strength of alloy XR at 800 to 1000°C under the influence of impure helium environment has been critically discussed. Oxidation kinetics of the alloy in the helium environment was not seen to be accelerated by the in creep deformation appreciably within the range of conditions tested. The duplex-structure oxide film formed on Hastelloy alloy XR, being composed of $MnCr_2O_4$ spinel type oxide and Cr_2O_3, maintained its function up to the creep strain of a few per cent, and the degree of carburization occurred during the steady creep stage was not affected by the deformation. After the onset of accelerating creep and the resultant initiation of the surface cracks, however, the continuity of the oxide film was lost to cause severe carburization. Parallel to those tests, the same material was pack-carburized up to the carbon content of about 0.4 wt%. The treatment caused decrease in both rupture elongation and strength. Based on the observed facts, a concept of conservatism to be included in the predictive evaluation was proposed in the estimation of the long term creep rupture strength of Hastelloy alloy XR in the HTGR impure helium environment. It is concluded that the 50% value of the rupture life in inert environment is the presently most conservative rupture life of Hastelloy alloy XR in HTGR helium environment.

776 **(JAERI-M—82-036) Analytical evaluation of the environment effect on creep rupture strength.** Tamura, M.; Ogawa, Y.; Kurata, Y.; Kondo, T. (Japan Atomic Energy Research Inst., Tokyo). Apr 1982. 22p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703708.

An analytical approach was made in evaluating semi-quantitatively the effect of environment on rupture strength of materials. In the analysis the zone formed in the material by reaction with the environment was assumed to bear the applied load as one of the strength members. In calculations a law of mixtures of creep strength and the linear damage rule were applied. In the modeling of the load bearing by the composite structure of the environment-affected and intact zones, both parallel and series models were considered to formulate the equations. The equation for the parallel-loaded model was properly adopted in explaining semi-quantitatively the case of Incoloy alloy 800 crept in air, which was strengthened with the layer formed by nitrization. The equation for the serially loaded model was more successfully adopted to the evaluation of the rupture strength of dissimilar weld joints. The latter was also considered to be potentially adoptable to the problems of the effect of specimen size and shape on rupture strength, which had been often taken into account in evaluating the environment effect. For application of the developed method, examination was made to the possible decrease in rupture strength of Hastelloy alloy XR in long term tests by the formation of Cr depleted zone due to oxidation in HTGR impure helium, and the results were compared with the values obtained by experiments.

777 **(Juel—1819) Determination of the critical exponent β for dilute magnets by neutron diffraction.** Schneider, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Bochum Univ. (Germany, F.R.)). Dec 1982. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE83751344.

The critical behaviour of the dilute antiferromagnetic substance (Crsub(x)Alsub(1-x))$_2O_3$ is measured by neutron diffraction and the critical exponent β of the magnetization of the sublattices is determined as a function of the concentration ratio. (Crsub(x)Alsub(1-x))$_2O_3$ is an Ising system with statistically distributed local magnetic moments. For growing dilution of the magnetic moments and close by the percolation limit a raise of the exponent β is observed. Thus the result supports the theory that the exponent β depends on the concentration.

778 **(KFK—3499) Influence of solutes on heavy ion induced void-swelling in binary copper alloys.** Leister, K.H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau). May 1983. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83751337.

As radiation induced swelling of metals depends on their constitution, swelling of copper and copper alloys with low solute concentration is studied. Diffusion coefficients and solubility of solute in copper were used as criteria of selection of the alloys. The samples were irradiated by 200keV copper ions. Swelling and void densities were measured by transmission electron microscopy. The measurements show low dependence of swelling upon the diffusibility of the solute in the solvent and a strong dependence on their concentration. Alloys of 0.1at% solute show more swelling than pure copper, and alloys of 1at% show less swelling under the irradiation conditions. The different swelling behavior in Cu-Ni alloys is due to the different void densities.

779 **(LA-UR—83-2890) Low-hysteresis materials for magnetic refrigeration: Gd/sub 1-x/Er/sub x/Al$_2$.** Zimm, C.B.; Barclay, J.A.; Johanson, W.R. (Los Alamos National Lab., NM (USA); Pomona Coll., Claremont, CA (USA)). 1983. Contract W-7405-ENG-36. 10p. (CONF-831187—5). NTIS, PC A02/MF A01. Order Number DE84001685.

From MMM conference; Pittsburgh, PA, USA (8 Nov 1983).

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The series of ferromagnetic intermetallics Gd/sub 1-x/Er/sub x/Al$_2$ are candidate working materials for magnetic refrigeration because of their large moment, small anisotropy, and the fact that their Curie temperatures span the range 14 K to 164 K. We have measured the magnitude of the magnetic hysteresis as a function of temperature from 4 K to T/sub c/ for polycrystalline samples of these materials via ac magnetic susceptibility and magnetization hysteresis loops. We found, as expected, virtually no hysteresis in GdAl$_2$, and more surprisingly, less than 3000 A/m hysteresis in ErAl$_2$, and 2 x 10^4 A/m in Gd$_{0.8}$Er$_{0.8}$Al$_2$. Moreover, the hysteresis in Gd$_{0.8}$Er$_{0.8}$Al$_2$ was $\leqq$ 100 A/m for T - T/sub c/ < 20 K.

780 **(LA-UR—83-2928) Structural studies at elevated pressure and reduced temperatures using synchrotron radiation: application tocerium)$_x$lanthanum)$_1$thorium)$_1$.** Skeleton, E.F.; Webb, A.W.; Elam, W.T.; Wolf, S.A.; Qadri, S.B.; Huang, C.Y.; Chaikin, P.M.; Lacoe, R.C.; Gschneidner, K.A. (Naval Research Lab., Washington, DC (USA); Sachs/Freeman Associates, Inc., Bowie, MD (USA); Los Alamos National Lab., NM (USA); California Univ., Los Angeles (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1983. Contract W-7405-ENG-36. 6p. (CONF-831194—1). NTIS, PC A02/MF A01. Order Number DE84001793.

From 9. AIRAPT international conference on high pressure science and technology; Pittsburg, PA, USA (8 Nov 1983).

A facility is described which has been developed at the Stanford Synchrotron Radiation Laboratory for the rapid acquisition of structural information from a sample pressurized in a diamond-anvil cell and cooled to cryogenic temperatures. The system employs a closed-cycle He-refrigerator which can be continuously operated, independent of any liquid cryogens, from a remote control station; the sample temperature can be maintained constant to better than 0.05 K. The compressive contact force between the diamond anvils, and hence the sample pressure, is also externally controlled, thereby providing remote control capabilities for both the pressure and the temperature. Preliminary data on the critical points and volume changes associated with the pressure/temperature induced isomorphic phase transition in $Ce_xLa_1Th_1$ are presented.

781 **(LA-UR—83-2929) Relaxations in spin glasses: similarities and differences from ordinary glasses.** Ngai, K.L.; Rajagopal, A.K.; Huang, C.Y. (Los Alamos National Lab., NM (USA); Naval Research Lab., Washington, DC (USA); Louisiana State Univ., Baton Rouge (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-831187—6). NTIS, PC A02/MF A01. Order Number DE84001719.

From MMM conference; Pittsburgh, PA, USA (8 Nov 1983).

Relaxation phenomena have become a major concern in the physics of spin glasses. There are certain resemblances of these relaxation properties to those of ordinary glasses. In this work, we compare the relaxation properties of spin glasses near the freezing temperature with those of glasses near the glass transition temperature. There are remarkable similarities between them and they both are in conformity with two coupled universality relations predicted by a recent model of relaxations in condensed matter.

782 **(LA-UR—83-3064) Impurities in the heavy-Fermion superconductor UBe_{13}.** Smith, J.L.; Fisk, Z.; Willis, J.O.; Batlogg, B.; Ott, H.R. (Los Alamos National Lab., NM (USA); Bell Labs., Murray Hill, NJ (USA); Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1983. Contract W-7405-ENG-36. 20p. (CONF-831187—7). NTIS, PC A02/MF A01. Order Number DE84001731.

From MMM conference; Pittsburgh, PA, USA (8 Nov 1983).

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Small amounts of Sc, Lu, Gd, Np, Ce, Th, La, and Ba have been substituted for uranium in UBe_{13} to observe their effects. The thorium, which was the most complete study, resulted in an extremely unusual nonmonotonic depression of the transition temperature for a nonmagnetic impurity. This comes from an interplay that exists between the lowest temperature resistivity peak and the transition temperature, as the peak is depressed. These results suggest tat heavy Fermion behavior is only a necessary condition for heavy Fermion superconductivity. All of the impurities tested resulted in a transition temperature depression.

783 **(LBL—16186) Infrared optical properties of the quasi-one-dimensional conductors $NbSe_3$ and $(TMTSF)_2ClO_4$.** Challener, W.A. IV. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 195p. NTIS, PC A09/MF A01. Order Number DE84000940.

Thesis.

The technique of far-infrared Fourier-transform spectroscopy has been used to study the properties of two materials, $NbSe_3$ and $(TMTSF)_2ClO_4$. $NbSe_3$ undergoes incommensurate charge-density-wave (CDW) transitions and exhibits electrical transport by sliding CDW's. $(TMTSF)_2ClO_4$ undergoes order-disorder, spin-density-wave, and superconducting transitions at ambient pressure. It is a member of the first class of organic materials to be synthesized which exhibit superconductivity. We have done a Kramers-Kronig analysis of the far-infrared reflectance of $NbSe_3$ to obtain an estimate of the optical constants. We have used models of the frequency-dependent conductivity to fit the data. General arguments show that at 2K a CDW energy gap exists between 120 and 190 cm^{-1}, the relaxation time(s) of the free carriers and CDW pinned mode is $>3 \times 10^{-12}$s, and the ratio of the free-carrier concentration to band mass is $<2 \times 10^{20}$ cm^{-3}/m_0. The strength of the pinned mode obtained from the detailed fit is inconsistent with the classical model of CDW transport. We have also measured the far-infrared reflectance of $(TMTSF)_2ClO_4$ and performed a Kramers-Kronig analysis to obtain the optical constants. A large peak in the conductivity occurs above 100 cm^{-1}, and a smaller peak occurs at $\sim$ 25 cm^{-1}. We have no explanation at present for the large peak, but we believe that the small peak is a phase phonon. It occurs when the orientations of the ClO_4 anions order and thereby induce a charge-density wave in the lattice. Our data, however, are inconsistent with an interpretation based upon a theory of quasi-one-dimensional fluctuational superconductivity.

784 **(LBL—16380) Kinetics and energy transfer of gas-surface scattering.** Lin, T.H. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 172p. NTIS, PC A08/MF A01. Order Number DE84001838.

Thesis.

The residence time of CO on Pt(111) and Pt(557) indicates that while CO can be adsorbed at both step and terrace sites, the desorption kinetics are controlled by the steps. The kinetics of NO/Pt were found to be more complex than those of CO/Pt. The data indicate that one high adsorption energy state is sampled above 525K and a lower adsorption energy state appears suddenly below 480K. The distribution of energy among all the modes has been measured for NO scattered from Pt(111). The translational and vibrational energy accommodation coefficients are nearly equal to one for T/sub s/ $<$ 900K and deviate from unity above this temperature due to nonequilibrated desorption. The rotational energy acommodation is very poor compared with that of the other two modes. The H_2-D_2 exchange reaction on Pt(557) was found to proceed via a Langmuir-Hinshelwood mechanism. Although the angular distribution of the HD product is slightly peaked at the normal, the velocity distribution is slightly colder than the substrate and the deviation increases as the detection angle increases. With atomic hydrogen and deuterium incident beams, the velocity of desorbing HD molecules increases as the crystal temperature decreases from 300 to 200K. At 200K, the velocity distribution is wider than Maxwellian and there is considerable HD leaving the surface with 1915K translational energy. The waveform indicates that the residence time decreases for some of the incident atoms from 300 to 200K, and that at high coverages some of the incident atoms can recombine before reaching thermal equilibrium.

785 **(LBL—16594) Alkali monolayers on transition metal surfaces: electronic promotion in catalysis.** Garfunkel, E. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 266p. NTIS, PC A12/MF A011. Order Number DE84002570.

Thesis.

Potassium monolayers on the platinum (111) crystal surface were studied most extensively. Ultraviolet photoelectron spectroscopy showed a large decrease in the work function of the surface when potassium was adsorbed. The heat of desorption of potassium decreased with increasing coverage. Low energy electron diffraction (LEED) showed that potassium forms hexagonal (close packed) overlayer structures. The effects of potassium on the chemisorption of various small molecules on Pt(111) were studied. Oxygen and nitric oxide were readily adsorbed and dissociated by potassium, forming stable potassium-oxide complexes on the surface. Adsorption heat of carbon monoxide on Pt(111) increased with potassium coadsorption. High resolution electron energy loss spectroscopy showed that the carbon-oxygen bond of adsorbed carbon monoxide was weakened by potassium. Adsorption heat of benzene, however, was decreased by coadsorbed potassium. A molecular orbital explanation was given to explain the effects of potas-

sium. CO hydrogenation reactions performed on metal foils showed that the addition of alkali adlayers tends to decrease the overall rate of reaction. Changes in selectivity were noted, shifting the product distribution in favor of higher molecular weight species and from alkanes to alkenes.

786 **(LBL—16616) High-temperature oxidation of nickel-cobalt alloys.** Hou, P.Y. (Lawrence Berkeley Lab., CA (USA)). Mar 1983. Contract AC03-76SF00098. 99p. NTIS, PC A05/MF A01. Order Number DE84001878.

Thesis.

The oxidation of Ni-Co alloys under two extremes of oxygen potentials at 1000°C is studied. In both cases, an external solid-solution oxide scale is formed with extensive internal oxide formation in alloys oxidized under the low oxygen potential. Selective oxidation of the metal with the more-stable oxide, CoO, is observed when the ambient oxidizing potential is low, and as a consequence, the oxidation rate constant increases according to the degree of selective oxidation. The growth of the external oxide scale is described using Wagner's ternary diffusion model. A more-refined defect model, which includes the presence of all types of vacancy species within the scales, is adapted to obtain the diffusivities of cations in the scales as a function of oxygen potential and cation composition. In addition, correlation effects between elementary jumps of the cations are included to account for additional compositional dependence of the diffusivities. Theoretical calculations on the oxidation rate constants and the cation concentration profiles are compared with experimentally measured data. 36 figures.

787 **(N—8322416) Measurement of low corrosion rates: Comparison of AC impedance and thin layer activation methods.** Williams, D.E.; Asher, J. (UKAEA Atomic Energy Research Establishment, Harwell). Jan 1983. 25p. (AERE-R—10477). Avail: Issuing Activity.

The very low corrosion rate (0.05 to 1 micron year) of 18Cr13Ni1Nb stainless steel in 7.8M HNO_3 at room temperature was determined with some confidence in a period of a few days by the combination of AC impedance and a radiotracer technique, thin layer activation. Both techniques were taken to their limits. It is argued that the AC method gives an upper estimate for the corrosion rate whilst the tracer method gives a lower estimate. Application of the AC method requires an estimate of the Tafel parameter relating corrosion rate and polarization resistance: an approximate method, utilizing the variation of the apparent value of the polarization resistance with the amplitude of the AC signal, is given in this paper. The corrosion rate decreased steadily with time over the first few days of exposure of the polished steel surface to the acid.

788 **(ORNL/TM—8854) Mechanical-property characterization of an electroslag-cast valve body of CF8M composition.** Hotsur, Y.L.; Sikka, V.K. (Oak Ridge National Lab., TN (USA)). Nov 1983. Contract W-7405-ENG-26. 67p. NTIS, PC A04/MF A01. Order Number DE84002253.

This initial investigation into electroslag casting involves the mechanical property study of a type 316 stainless steel (CF8M) valve body section (obtained from the University of British Columbia). The casting was subjected to tensile, creep, Charpy V-notch, and microhardness testing as well as an optical metallography, scanning electron microscopy, and transmission electrom microscopy. Tensile tests were conducted in the as-cast and solution-annealed conditions at room and elevated temperatures. Charpy impact testing was performed at room temperature on as-cast and solution-annealed specimens. Creep-deformation properties of the casting were obtianed at 649°C (1200°F) within a stress range from 90 to 170 MPa (13 to 25 ksi) in the as-cast state. Investigations into the creep behavior of this stainless steel electroslag casting are ongoing. Mechanical testing was conducted on specimens from three levels of the casting in both the longitudinal and transverse directions. Comparisons made between the as-cast and solution-annealed specimens indicate that annealed specimens (in most cases) have better mechanical properties. This can be attributed to the dissolution of precipitated Fe-Cr-Mo microconstituents (sigma, chi, metal carbides, etc.) during the solution treatment. In general, though, preliminary results show that the electroslag castings have properties competitive with those of conventional sand castings.

789 **(PNL-SA—11321) Radiation-induced phosphorus segregation in austenitic and ferritic alloys.** Brimhall, J.L.; Baer, D.R.; Jones, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 6p. (CONF-830942—53). NTIS, PC A02/MF A01. Order Number DE84000903.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

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The radiation induced surface segregation (RIS) of phosphorus in stainless steel attained a maximum at a dose of 0.8 dpa then decreased continually with dose. This decrease in the surface segregation of phosphorus at high dose levels has been attributed to removal of the phosphorus layer by ion sputtering. Phosphorus is not replenished since essentially all of the phosphorus within the irradiation zone has been segregated to the surface. Sputter removal can explain the previously reported absence of phosphorus segregation in ferritic alloys irradiated at high doses (> 1 dpa) since irradiation of ferritic alloys to low doses has shown measurable RIS. This sputtering phenomenon places an inherent limitation to the heavy ion irradiation technique for the study of surface segregation of impurity elements. The magnitude of the segregation in ferritics is still much less than in stainless steel which can be related to the low damage accumulation in these alloys.

790 **(PNL-SA—11364) Pulsed-ion-irradiated microstructures in molybdenum.** Brimhall, J.L.; Simonen, E.P.; Charlot, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 6p. (CONF-830942—47). NTIS, PC A02/MF A01. Order Number DE84000679.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

Pulsed irradiation of molybdenum in the temperature range from 1025 to 1225 K primarily retarded void nucleation. The reduction in nucleation rate could be attributed to a throttling effect caused by annealing out of subcritical void embryos. The more rapid development of the dislocation microstructue during pulsing also contributed to a reduction in void nucleation rate. Once nucleation was complete, microstructural development was not affected by pulsed irradiation compared to steady irradiation. Little pulsing effect on total void swelling or swelling rate was observed. A proposed increase in swelling caused by disintegration of depleted zones during pulsed annealing periods was not observed.

791 **(PNL-SA—11365) Dislocation/obstacle interactions during low-dose irradiation creep of nickel.** Henager, C.H.; Bradley, E.R.; Simonen, E.P.; Stang, R.G. (Pacific Northwest Lab., Richland, WA (USA); Washington Univ., Seattle (USA). Dept. of Mining and Metallurgical and Ceramic Engineering). Sep 1983. Contract AC06-76RL01830. 6p. (CONF-830942—52). NTIS, PC A02/MF A01. Order Number DE84001416.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

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Analyses of interactions between gliding dislocations and irradiation-induced obstacles indicated that loop unfaulting, loop annihilation, and loop sweeping can control low-dose irradiation creep in fcc metals. Dislocation reactions remove glide barriers from active slip planes and rationalize rapid creep rates observed in deuteron irradiated nickel. Irradiation creep experiments revealed that pre-irradiation reduced irradiation creep rates in annealing Ni whereas pre-irradiation had little effect on creep rates in cold-worked Ni. Dislocation/obstacle interactions and the role of the applied stress in barrier removal processes were related to observed irradiation creep responses.

792 **(SAND—83-1254C) Measurement of precipitate nucleation times in molten metals by pulsed surface melting.** Follstaedt, D.M.; Picraux, S.T.; Peercy, P.S.; Knapp, J.A.; Wampler, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 7p. (CONF-831174—5). NTIS, PC A02/MF A01. Order Number DE84002383.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

The short melt duration resulting from pulsed laser and electron beam surface melting of ion-implanted metals has been used to measure precipitate nucleation times of compounds within the melt. We have examined the phases present in several alloy systems with TEM and used calculated thermal histories to place limits on the time required for nucleation of the following compounds: AlSb (5 to 25 ns), Al_3Ni (≧ 750 ns), Al_3Ni_2 (≧ 950 ns) and AlNi (< 1000 ns), all in molten Al, and TiC (≦ 100 ns) in molten Fe. The compounds observed after our rapid solidification have relatively simple, cubic structures and melt congruently, while those predicted but not observed have more complex structures and decompose peritectically.

793 **(SAND—83-1907) Approximate linear stability analysis of a model of adiabatic shear-band formation.** Burns, T.J. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01. Order Number DE84001918.

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The formation of adiabatic shear bands in ductile metals under dynamic loading conditions is generally thought to result from a material instability, which is associated with a peak in the curve of engineering plastic flow stress vs engineering shear strain. This instability arises from the effect of thermal softening, caused by irreversible adiabatic heating, which counteracts the tendency of the material to harden with increasing plastic strain. An approximate linear stability analysis of a one-dimensional rigid-thermoviscoplastic model, based on data taken from dynamic torsion experiments on thin-walled tubes of mild steel, shows that shear band formation in this situation can be interpreted as a bifurcation from a homogeneous simple shearing deformation which occurs at the peak in the homogeneous stress vs strain curve. The asymptotic method of multiple scales is used to show that the growth rate of small perturbations on the homogeneous deformation is controlled by the ratio of the slope of the homogeneous stress vs strain curve to the material viscosity, i.e., the rate of change of the plastic flow stress with respect to the strain-rate. In addition, it is shown that this growth rate is essentially independent of wavelength in any small perturbation. Numerical methods are used to show that this growth rate beyond the bifurcation point may not be sufficiently large for the model to account for the experimental data, and some suggestions are made on how to modify the constitutive equation so that it better fits the experimental data.

794 **(UCRL—89424) Metallurgical explanation of double magnetic transitions and allied phenomena in AuFe alloys.** Borg, R.J.; Violet, C.E. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1983. Contract W-7405-ENG-48. 12p. (CONF-831187—8). NTIS, PC A02/MF A01. Order Number DE84002024.

From MMM conference; Pittsburgh, PA, USA (8 Nov 1983).

Evidence for two magnetic ordering temperatures in AuFe alloys ($0.1 < X/sub\ Fe/ < .25$) is given by a.c. and static susceptibility measurements and Moessbauer experiments. These data have given rise to a variety of qualitative to semi-quantitative theories based upon fluctuations in the random distribution of Fe atoms. Our explanation of the two ordering temperatures is based upon the precipitation of a metastable Fe enriched phase which arises via a spinodal decomposition and which magnetically couples to the spin glass matrix. The high temperature transition denotes the onset of ferromagnetic order within the precipitate whose field is then locally coupled to the paramagnetic matrix. When the temperature of the system is decreased below the spin glass ordering temperature the apparent high temperature ferromagnetic character is destroyed, attesting to the dominance of the random spin glass structure and the strength of the coupling between the two phases. Hence, it is the temperature dependence of the coupling between distinguishable phases as well as the nature of the magnetic order which produces the double transition.

795 **(Y—2285) Reversible strain mechanisms in uranium-niobium alloys near the monotectoid composition.** Vandermeer, R.A.; Dobbins, A.G.; Carpenter, D.A. (Oak Ridge Y-12 Plant, TN (USA)). Oct 1983. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE84002686.

The early-stage reversible deformation mechanisms of water-quenched α'' martensite in uranium-niobium alloys near the 6 wt % niobium composition have been studied using tensile testing, x-ray diffraction analysis, optical metallography, and dilatometry. Intervariant interfaces were found to be very mobile and moved easily under low stress. Their movement caused variant growth and conversion, which generated a preferred orientation. Martensite variant conversion was proposed to be the source of the latent strain that can be released if the martensite undergoes phase reversion. A mechanism for such behavior, known as the shape memory effect (SME), has been proposed.

796 **(Y/DV—205) Ion plating in corrosion protection.** Vest, G.W. (Oak Ridge Y-12 Plant, TN (USA)). 8 Sep 1983. Contract W-7405-ENG-26. 35p. (CONF-8105139—14). NTIS, PC A03/MF A01. Order Number DE84001182.

From ASM metallurgical technology of uranium and uranium alloys seminar; Gatlinburg, TN, USA (26 May 1981).

The ion plating process and the associated advantages and disadvantages of this coating method are described. The specific example of ion plating aluminum onto the uranium-0.8 weight percent titanium alloy is covered in detail. The corrosion properties of the plated alloy are related back to the process variables, and the coating layer and interface region are characterized.

797 **(ZfK—474) Concentration dependence of Co sorption on corrosion product oxide layers on austenitic steel at 368 K (95°C).** Rommel, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1982. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703701.

The Co sorption on corrosion products of stainless steel is a chemisorption process of hydroxocation $Co(OH)^+$. Its dependence upon concentration and pH may be described quantitatively by an absorption equation of Freundlich-type. A relation for the concentration of the monolayer was derived and the value calculated from measuring data.

798 **Direct determination of a radiation damage profile with atomic resolution in ion-irradiated platinum.** Pramanik, D.; Seidman, D.N. (AMI, Santa Clara, California 95051). *Applied Physics Letters;* **43**: No. 7, 639-641(1 Oct 1983).

The field-ion microscope technique has been employed to determine directly a radiation damage profile, with atomic resolution, in a platinum specimen which had been irradiated at 60 K with 20-keV Kr^+ ions to a fluence of 5×10^{12} cm^{-2}. It is shown that the microscopic spatial vacancy distribution (radiation damage profile) is directly related to the elastically deposited energy profile. The experimentally constructed radiation damage profile is compared with a theoretical damage profile: calculated employing the transport of ions in matter (TRIM) Monte Carlo code: and excellent agreement is obtained between the two. Thus, it is demonstrated that it is possible to go directly from a microscopic spatial distribution of vacancies to a continuous radiation damage profile.

799 **Work function of Mo(110) in mixed cesium and cesium monoxide vapors.** Desplat, J. (Rasor Associates, Inc., 253 Humboldt Court, Sunnyvale, California 94089). *Journal of Applied Physics;* **54**: No. 9, 5494-5497(Sep 1983).

Electron emission measurements from a Mo(110) emitter are performed in a diode containing both cesium and cesium monoxide vapors over a temperature range from 500 to 1800 K. The vapor pressures can be varied independently within a limited range: typical values are 1×10^{-3} and 2×10^{-4} Torr for cesium and Cs_2O, respectively. At temperatures above 1000 K, the electron emission is increased by several orders of magnitude over that obtainable with cesium vapor alone by the addition of Cs_2O. This is believed to result from the dissociation of Cs_2O molecules adsorbed on the emitter surface to form an adsorbed oxygen layer. At temperatures

below 700 K, the work function decreases with temperature to as low as 1.2 eV around 500 K. This is interpreted as resulting from multilayer deposition of Cs_2O. Application to thermionic converters is discussed.

800 **Kinetics of H_2 adsorption on and desorption from cobalt and the effects of support thereon.** Zowtiak, J.M.; Bartholomew, C.H. (Brigham Young Univ., Provo, UT). *Journal of Catalysis;* **83**: No. 1, 107-120(Sep 1983). Contract AC02-81ER10855.

The technique of temperature-programmed desorption (TPD) was applied to the investigation of hydrogen adsorption/desorption from a series of cobalt catalysts. Experiments in which the adsorption temperature was varied revealed that hydrogen adsorption on cobalt is activated and that the activation energy for adsorption is a function of catalyst support and metal loading. The activation energy for adsorption ranged from 5.8 kJ/mol for unsupported cobalt to 43 kJ/mol for 3% cobalt (Co) on silica (SiO_2). Desorption runs on selected catalysts showed hydrogen desorption to be second order, the heat of adsorption ranging from 145 kJ/mol on 10% Co/SiO_2 to 105 kJ/mol on 10% Co/Al_2O_3 (alumina). Desorption from unsupported, silica-, and alumina-supported catalysts involved one major peak suggesting the presence of only one type of site while the titania- and carbon-supported catalysts displayed multiple desorption peaks providing evidence of a more complex distribution of surface sites possibly as a result of metal-support interactions. No H_2 adsorption was detected for magnesia-, ZSM-5 (zeolites), and lower loading (1 and 3%) alumina-supported cobalt catalysts at any temperature using flow adsorption/desorption techniques, even though these catalyst adsorbed hydrogen at temperatures ranging from 25 to 150°C using the static, equilibrium technique. These results suggest that strong metal-support interactions in these catalysts may lead to a strongly activated adsorption of hydrogen on cobalt. 11 figures, 3 tables.

801 **Collective behavior of magnons in superlattices.** Grimsditch, M.; Khan, M.R.; Kueny, A.; Schuller, I.K. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **51**: No. 6, 498-500(8 Aug 1983).

The magnon spectrum characteristic of collective behavior in magnetic/nonmagnetic superlattices has been observed, and is in good agreement with theoretical predictions.

802 **Effect of high magnetic fields on the heat capacity of strongly Pauli-paramagnetic Pd-Ni alloys.** Ikeda, K.; Gschneidner, K.A. Jr.; Schindler, A.I. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **28**: No. 3, 1457-1465(1 Aug 1983).

The low-temperature [(1.3—20.0)-K] heat capacity of strongly Pauli-paramagnetic Pd-Ni alloys containing 0.47 and 0.97 at. % Ni was measured in magnetic fields up to 10 T. The electronic specific-heat constant becomes smaller with increasing fields (12% or 13% at 9.98 T). This is probably due to the depression of the spin-fluctuation enhancement of heat capacity by the high magnetic fields and is in accord with the recent theoretical predictions. The coefficient β of the T^3 term in the heat capacity becomes larger with increasing fields and at H> or ≈5.39 T it reaches almost the same value as that for alloys containing more than ~5 at. % Ni. Two possible mechanisms have been proposed to account for the increase in β: (1) The increase is due to the magnetic quenching of localized spin fluctuations in the vicinity of the nickel atoms, or (2) the increase is due to a magnetic contribution to the heat capacity which results from an induced magnetic moment on the nickel atoms by the applied magnetic field. Additional experiments are needed to determine which mechanism is the correct one.

803 **Formation of an amorphous alloy by solid-state reaction of the pure polycrystalline metals.** Schwarz, R.B.; Johnson, W.L. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **51**: No. 5, 415-418(1 Aug 1983). Contract AT03-81ER10870;AM03-76SF00767.

Single-phase Au/sub 1-x/La/sub x/ alloys, with 0.3< or ≈x< or ≈0.5, have been formed through solid-state interdiffusion of pure polycrystalline Au and La thin films (100—600 A) at temperatures of 50—80 °C. The reaction is driven by the large negative heat of mixing in the amorphous alloy and occurs at low temperatures by the anomalously fast diffusion of Au in La. The composition regime giving a single-phase amorphous product is explained with use of a free-energy diagram.

804 **High-field specific heat of the spin-fluctuation system UAl_2.** Stewart, G.R.; Giorgi, A.L.; Brandt, B.L.; Foner, S.; Arko, A.J. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **28**: No. 3, 1524-1528(1 Aug 1983).

Measurements of the low-temperature specific heat, both in 0- and 7-T applied field, and magnetic susceptibility on polycrystalline, unannealed single-crystal and annealed single-crystal samples of UAl_2 show no sample dependence for these properties to +-5%, in contrast to recent results for $TiBe_2$. Measurements of the specific heat of the annealed single crystal of UAl_2 from 2 to 23 K in fields to 12.5 T and from 4 to 16 K in fields to 17 T indicate a partial (~40%) suppression of the spin-fluctuation contribution, which occurs at 2 K in 12.5 T, and the possible existence of a small competing effect which increases the specific heat with increasing field above 4 K. These results are compared with recent magnetization and magnetoresistivity results which indicate suppression of spin fluctuations in UAl_2 between 15 and 20 T.

805 **Holstein-Primakoff theory for many-body systems.** Mead, L.R.; Papanicolaou, N. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] B: Condensed Matter;* **28**: No. 3, 1633-1636(1 Aug 1983). Contract W-31109-ENG-38.

We discuss the relationship between generalized coherent states and suitable extensions of the Holstein-Primakoff theory of quantum spin systems, illustrating the common origin of a variety of semiclassical approximation schemes encountered in many-body theory.

806 **Theoretical studies of point defects and diffusion in Nb_3Sn.** Welch, D.; Diennes, G.; Hatcher, R.; Lazareth, O. (Brookhaven Nat'l Lab, Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 889-892(May 1983). Contract AC02-76CH00016.

The structure and energetics of several simple point defects in A15 Nb_3Sn were investigated by means of computer simulations based on a pair-potential model of cohesion. The properties of vacancies on both the Nb and Sn sublattices, as well as those of simple antisite defects, were examined, and estimates were made of the energetics of several types of atom vacancy exchange ("jump") processes. The results show an unusual structure for the vacancy on the Nb sublattice: the vacancy is "split" between two adjacent sites along the Nb chain with an atom midway between them. We find the Sn vacancy (on the Sn sublattice) to be metastable; this vacancy will "decompose" by an activated process into a more stable configuration consisting of a Nb atom on a Sn site adjacent to a split Nb-sublattice vacancy. The authors find that the lowest energy grouping of defects compatible with maintaining sublattice sites in the proper three-toone ratio is the antisite defect pair; the lowest energy grouping which contains vacancies is found to consist of Nb-sublattice vacancies and Nb-on-Sn sublattice antisite defects in the ratio of four of the former to one of the latter (quirtuple defects). The results also suggest that bulk Sn diffusion is slower than Nb diffusion; this is consistent with the belief that rapid Sn diffusion during Nb_3Sn layer growth does not occur by bulk but by grain-boundary diffusion.

807 **(ORNL-tr—4957) Electrolyte for anodic oxidation of titanium alloys.** Batrakov, V.P.; Pivovarova, L.N.; Pivavorov, A.S.; Elidkumson, G.M.; Chukhin, V.V.; Zakharova, L.V. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. Translation of Russian Patent No. 2,862,389-22-02. 4p. NTIS, PC A02/MF A01. Order Number DE84002672.

The invention involves the electrolytic production of oxide films on titanium alloys which operate both under conditions of dry friction and with the use of lubricants. The purpose of the invention is to increase the antifriction properties of oxide films. The goal is accomplished by adding orthophosphoric acid and a surfactant to an electrolyte containing sulfuric acid and particles of a solid lubricant. (LEW)

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 274, 276, 277, 962, 1025, 1148

808 **(BMI—2110) Failure of ceramics from multiaxial stresses. Progress report, November 1, 1982-October 31, 1983.** Rosenfield, A.R.; Duckworth, W.H.; Shetty, D.K.; Pan, J. (Battelle Columbus Labs., OH (USA)). 28 Oct 1983. Contract W-7405-ENG-92. 4p. NTIS, PC A02/MF A01. Order Number DE84002352.

Object is to develop an understanding of the response of ceramic materials to complex stress states. During this period, attention was focused on specimens containing indenter flaws, essentially two semi-elliptical surface cracks perpendicular to one another and to the surface. Biaxial flexure tests with indenter flaws showed evidence of higher fracture stresses relative to uniaxial tests. Tension-compression experiments using diametral compression loading of disks did not show any evidence of stress-state effect. Other research topics included effect of crack branching on physical properties, and analysis of biaxial strength.

809 **(CONF-8310183—2) Damage processes in sliding partially stabilized zirconia pairs.** Yust, C.S.; Carignan, F.J. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE84001884.

From International symposium on ceramic components for engines; Hakone, Japan (17 Oct 1983).

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The dry sliding wear coefficients for partially stabilized zirconia (PSZ) paired with silicon nitride, silicon carbide, alumina, and a transformation toughened alumina are reported. A pin-on-disc test device was used to measure wear at temperatures of 20°C, 205°C, and 425°C in an inert atmosphere. The standardized test conditions applied were (a) a normal force of 9.0 N, (b) surface velocity of 0.3 m/s, and (c) a test duration of 2 h. The wear rates measured fell within the range of 10^{-6} to 10^{-3} (mm^3/N.m), while the corresponding coefficients of friction were in the range of 0.7 to 1.0. A notable exception is the friction coefficient value of 0.2 measured on a PSZ/PSZ pair teted at 20°C. The wear surfaces were examined by scanning electron microscopy, and the interface conditions observed are discussed.

810 **(DFVLR-FB—83-09) Prediction of lifetime for ceramic materials in the elastic and viscoelastic region by fracture mechanical methods.** Fett, T. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). 16 Mar 1983. 240p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE83751339.

The investigation is mainly concerned with the effect of subcritical crack growth of ceramic materials on lifetime in static bending test and lifetime predictions. In the theoretical part the formulas of lifetime and dynamic bending strength are discussed in detail. In case of creep behaviour a procedure is proposed to make predictions possible. The experiments on Al_2O_3 and HPSN give a good agreement between predicted and measured lifetimes for linear elastic material behaviour. If creep behaviour dominates, the region of expected lifetimes and the qualitative shape of lifetime distribution can be predicted too.

811 **(DOE/ER/10588—4) Physics and chemistry of packing fine ceramic powders. Annual report, February 1, 1983-January 31, 1984.** Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge (USA). Ceramics Processing Research Lab.). 30 Sep 1983. Contract AC02-80ER10588. 177p. NTIS, PC A09/MF A01. Order Number DE84002047.

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The objective of the present research was to develop a scientific basis for processing ceramic powders. The key problem identified for conventional processing was the lack of control in the packing of submicron powders prior to sintering; thus, the formation, dispersion and packing of particles were the major areas of this study. Theoretical modelling and experimental measurements were used to understand the forces (predominantly electrostatic) between particles and hence enabled control of the packing of particles into uniform, densely packed bodies. Three model systems chosen for this research were SiO_2, TiO_2, and SiC. Surface electrochemical and physical characteristics have been measured for monodisperse SiO_2 and TiO_2. Close-packed (ordered) dispersions and green microstructures have been demonstrated for SiO_2 and TiO_2. The ordering studies, performed using a laser diffraction technique, have revealed possible deficiencies in existing order/disorder models. Coagulation model calculations demonstrated the effects of particle size and size distribution on slurry stability (i.e., distributions produced by milling are too wide to be electrostatically stable against coagulation). Sintering experiments on TiO_2 compacts indicated that particle packing in the green microstructure strongly affected sintering kinetics and the final microstructure; uniform, densely packed bodies sintered rapidly to near theoretical density with limited grain growth. These results provide direct evidence in support of the processing paradigm on which this research program was based.

812 **(LA-UR—83-3045) Novel hard metal compositions and properties.** Sheinberg, H. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 26p. (CONF-831246—1). NTIS, PC A03/MF A01. Order Number DE84001736.

From 3. international school on sintered materials; New Delhi, India (6 Dec 1983).

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A new family of hard metal compositions consisting primarily of borides, borpcarbides and carbides of nickel, iron and tungsten or molybdenum is made by reaction with small quantities of boron carbide. The hardness of these compositions is in the range of the hardest conventional tungsten carbide-cobalt compositios. Denisty of this family of materials can be varied from about 8 to 17 Mg/m^3 with only slight variations in hardness. Preliminary data on hot hardness, hardness, fracture toughness, and abrasion resitance are encouraging. 9 tables.

813 **(PNL-SA—11711) UO_2 oxidation at low temperatures in air.** White, G.D.; Gilbert, E.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 15p. (CONF-8310175—2). NTIS, PC A02/MF A01. Order Number DE84000936.

From 36. annual Pacific Coast Regional meeting of the American Ceramic Society; San Diego, CA, USA (3 Oct 1983).

The work reported here was initiated with the objective of establishing oxidation rates for unirradiated or irradiated pellets at temperatures of interest to fuel storage. The time to initiate a spalling and the composition of the oxidation products were determined. UO_2 pellets heated at 150°C for 12 months in air showed no weight gain. UO_2 pellets heated at 200, 215, 230, and 250°C in air all exhibited an induction period in which pellets gained weight before spalling began. At 230 and 250°C, pellet spalling was accompanied by the formation of U_3O_8; however, pellet spalling at 200 and 215°C produced powders containing U_3O_{10} and only small amounts of U_3O_8. At temperatures of 250° and below, UO_2 pellet grain expansion resulting from oxidation in air is accommodated by the cracking and parting of the gain surface, thus producing a spalled powder with a particle distribution similar to the grain size distribution of the pellet.

814 **(UCRL—88966) Fabrication of SiC, Si_3N_4 and AlN by combustion synthesis.** Holt, J.B.; Munir, Z.A. (Lawrence Livermore National Lab., CA (USA)). 6 Oct 1983. Contract W-7405-ENG-48. 9p. (CONF-8310183—1). NTIS, PC A02/MF A01. Order Number DE84001766.

From International symposium on ceramic components for engines; Hakone, Japan (17 Oct 1983).

Combustion synthesis is a process, which takes advantage of the high exothermic heat of many chemical reactions to form refractory compounds. Borides, carbides, and nitrides are a technologically important group of refractory materials. The new process is especially suited to form these compounds. The thrmodynamic and kinetic factors of the high temperature, self-propagating reactions are viral to the selection of suitable systems and optimization of the final product. It is important to understand the synthesis of SiC, Si_3N_4, and AlN by these combustion processes. The experimental difficulty in forming SiC is entirely different than for Si_3N_4 and AlN. The potential for this method of fabrication and the various procedures for using combustion synthesis is discussed.

815 **Formation of paramagnetic adsorbed molecules on thermally activated magnesium and calcium oxides. Further studies of carbon monoxide.** Morris, R.M.; Klabunde, K.J. (Kansas State University, Manhattan). *Journal of the American Chemical Society;* **105**: No. 9, 2633-2639(4 May 1983).

Adsorption of CO onto thermally activated MgO or CaO leads to the formation of a variety of adsorbed anionic species. Included is the $C_6O_6^{2-}$ species (rhodizonate), which can be converted to $C_6O_5^{2-}$ (croconate) by heating or by treatment with a variety of adsorbing secondary chemical reagents. The $C_5O_5^{2-}$ species is also favored when lower thermal activation temperatures (400-500 °C rather than 600-1000 °C) for the MgO and CaO are used. Paramagnetic anionic species also form during CO adsorption, and extensive ESR studies with computer simulations and chemical studies have indicated that the major radical anion is cyclic $C_6O_6^{3-}$. This rhodizonate trianion is adsorbed on the surface in such a way that only two carbons (using ^{13}CO) strongly interact magnetically with the unpaired spin density. Upon treatment of the adsorbed $C_6O_6^{3-}$. with heat, H_2HCl, H_2O, CO_2, or NH_3, other adsorbed conformers were identified on the basis of ESR studies. The trianion is inert at 25°C to N_2, C_2H_4, $C_6H_5CH_3$, and CH_4 and, in fact, can be prepared in the presence of $C_6H_5CH_3$.

816 **A crystal chemical study of stishovite.** Hill, R.J. (CSIRO, Part Melbourne, Victoria, Australia); Newton, M.D.; Gibbs, G.V. *Journal of Solid State Chemistry;* **47**: No. 2, 185-200(Apr 1983). Contract AC02-76CH00016.

The crystal structure of stishovite, SiO_2, a=4.1773(1), c=2.6655(1) angstrom, space groups $P4_2/mnm$, with Z=2, has been refined with 217 graphite-monochromatized MoKα data (2Θ max=120°) to R=0.012 (R/sub w/=0.014). Electron deformation density maps show a modest accumulation of charge density ascribed to partial covalent bonding in both the equatorial and axial bonds together with a delocalization of denstity in and around the shared octahedron edges with the shorter equatorial bonds showing higher peaks (0.47 e angstrom^{-3}) than the longer axial bonds (0.29 e angstrom^{-3}). Net atomic charges for Si and O determined by a population and K refinement by varying the occupancy and shape of their valence shells are +1.71 and -0.86(15)e, respectively. The observed structural distortions and charge distributions conform with the results of ab initio molecular orbital calculations undertaken on molecules designed to mimic the local geometry of the structure of stishovite. The Si-O bond length (1.73 angstrom) calculated for a neutral molecule with 6-coordinated Si is slightly shorter than that observed on the average (1.76 angstrom) for silicates and molecular crystals with 6-coodinated Si. In addition, the calculated geometrical parameters of two edge-sharing octahedra agree to within ~5% of the observed geometry of stishovite. The calculated charge on Si is indicated to increase with coordination number and bond length in agreement with the larger net charge recorded for stishovite as compared with that recorded for α-quartz, Q(Si)= +1.0e.Observed deformation maps are compared with theoretical ones calculated in the equatorial plan of the 6-coodinated molecule using molecular orbital theory with a split valence s, p basis supplemented with d-type polarization functions on Si.

817 **High precision in-pile measurement of the vapor pressure over high-purity UO_2.** Reil, K.O.; Breitung, W. (Sandia National Laboratories, Albuquerque, NM (USA)). pp 631-640 of Actes de la conference de Lyon. Vol. 4 (Proceedings of the LMFBR safety topical meeting. Vol. 4). Paris, France; SFEN (1982). (CONF-820704—).

From International topical meeting on LMFBR safety; Lyon, France (18 Jul 1982).

The results of pressure versus internal energy measurements on high-purity UO_2 are presented. The data are compatible with previous p-u results for uranium oxide if differences in fuel impurity levels and in test preparation procedures are considered.

818 **(ORNL-tr—5039) PSZ of high mechanical properties.** Kobayashi, K.; Masaki, T. Translated from *Seramikkusu ;* **17**: No. 6, 427-433(1982). Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01. Order Number DE83018172.

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Zirconia ceramics have become the most talked about ceramic among ceramics of high mechanical properties. This article, reviews these zirconia ceramics, mainly focusing on the SIPT PSZ and discusses their present status and problems. 14 figures.

3603 Composite Materials

REFER ALSO TO CITATION(S) 467

819 **(DOE/ER/10735—1) Viscoelastic loss characteristics of cord rubber composites. Final report, September 1, 1980-August 31, 1983.** Clark, S.K. (Michigan Univ., Ann Arbor (USA). Dept. of Mechanical Engineering). Sep 1983. Contract AC02-80ER10735. 43p. NTIS, PC A03/MF A01. Order Number DE84002369.

The viscoelastic loss characteristics of cord rubber composites are important in reducing the hysteretic losses of all reinforced products in the rubber industry, with particular attention to automobile tires. Both analytical and experimental programs were undertaken to define the cord rubber loss characteristics, and agreement was satisfactory between theoretical prediction and experimental measurement. Predictions were based on conversion to complex form of the Halpin-Tsai equations for defining the elastic properties of a single sheet of rubber coated fabric. Tubular specimens were subjcted to both cyclic tension and cyclic torsion as a measure of their internal loss characteristics.

820 **(ORNL-tr—5049) Study of a rapid method for determining the solid content of urea formaldehyde resin (plastic).** Qing, T.; Tsao, H. Translated from *Lin Yeh K'o Hsueh ;* No. 4, 441-445(Nov 1982). Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE84001189.

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The solid content values of the urea formaldehyde resin plastics determined by the pressure-reducing drying method are more accurate than those obtained with the electric drying method. This method reduces drying time and eliminates substantially the possibility of resin decomposition. Using the phosphoric acid hydrolysis method, it is concluded that decomposition (ionization) occurred on the urea formaldehyde resin when the electric drying method was used but not with the pressure-reducing drying method. Refractometry is an accurate and rapid procedure for determining the solid content of resins. It can reduce the measuring time considerably, from the original 4 to 5 hours to 5 to 10 minutes with an apparent increase in analytic efficiency. Using this procedure, it is possible to acquire basic data on solid content accurately during the resin synthetic process, making it very practical for the production stage.

3604 Polymers And Plastics

821 **(N—8322425) Mini-Seminar on Plastic in the 1980's.** (Council for Scientific and Industrial Research, Pretoria (South Africa)). Mar 1982. 81p. (CONF-8203150—). NTIS, PC A05/MF A01.

From Seminar on plastic in the 1980's; Pretoria, South Africa (1 Mar 1982).

The production of plastics is discussed. An overview of the South African plastics industry is given. The development of fiber reinforced plastic composites and their applications are discussed. The use of plastics in automobile manufacturing is discussed, as well as the industrial radiation processing of plastics and the use of plastics in the construction industry. Designing in plastics, with particular reference to the role of the mold designer is discussed. For individual titles, see N83-22426 through N83-22428.

822 **(N—8322427) Industrial radiation processing of plastics.** Dehollain, G.; Dehollain, G. (Council for Scientific and Industrial Research, Pretoria (South Africa)). Mar 1982. 7p. (CONF-8203150—). NTIS, PC A05/MF A01.

From Seminar on plastic in the 1980's; Pretoria, South Africa (1 Mar 1982).

The improvement of plastics and rubbers by irradiation is discussed. Some applications of radiation processing are discussed. Wire and cable represents the most important application. The manufacture of shrinkable tubing and polyethylene foams are discussed.

823 **(NUREG/CR—3151) Complex radiation degradation behavior of PVC materials under accelerated aging conditions.** Clough, R.L.; Gillen, K.T. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1983. Contract AC04-76DP00789. 21p. (SAND—82-1414). NTIS, PC A02/MF A01 - GPO. Order Number DE84002451.

The radiation degradation behavior of three commercial polyvinyl chloride (PVC) materials has been investigated. All three exhibit an interesting reversal in the trend of the tensile strength part way through the aging experiment: the tensile strength first drops, then rises. The early drop is associated with oxidative scission; the rise is associated with crosslinking and is preceded by the material reaching the gel point. It was also found that the tensile elongation tended to level out in advanced stages of aging with the leveling-out values dependent on the dose rate. These phenomena pose complications for the design of accelerated aging tests.

824 **(SAND—83-1367C) Inhomogeneous oxidation effects studied using density profiling and metallographic polishing techniques.** Gillen, K.T.; Clough, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 15p. (CONF-8310111—5). NTIS, PC A02/MF A01. Order Number DE84001539.

From 11. DOE annual compatibility meeting; Livermore, CA, USA (18 Oct 1983).

Heterogeneous degradation is often encountered in real-time and accelerated aging studies of polymers. Two techniques for studying inhomogeneous degradation are described. The first, cross-sectional metallographic polishing, offers a rapid means of detecting inhomogeneous effects. The second, density profiling, allows measurements to be made of the shapes of the degradation profiles.

825 **(SAND—83-2198) Modeling of skeletal members using polyurethane foam.** Sena, J.M.F.; Weaver, R.W. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1983. Contract AC04-76DP00789. 14p. NTIS, PC A02/MF A01. Order Number DE84002476.

At the request of the University of New Mexico's Maxwell Museum of Anthropology, members of the Plastic Section in the Process Development Division at SNLA undertook the special project of the Chaco Lady. The project consisted of polyurethane foam casting of a disinterred female skull considered to be approximately 1000 years old. Rubber latex molds, supplied by the UNM Anthropology Department, were used to produce the polymeric skull requested. The authors developed for the project a modified foaming process which will be used in future polyurethane castings of archaeological artifacts and contemporary skeletal members at the University.

826 **Diffusion of small molecules in polymers.** Frisch, H.L.; Stern, S.A. (A. B. Williams College, Williamstown, Massachusetts). *CRC Critical Reviews in Solid State and Materials Sciences;* **11**: No. 2, 123-185(Jul 1983).

This article reviews and discusses the phenomenology, theories, and methods of measurement of diffusion of small molecules in polymers. Both rubbery and glassy penetrant-polymer systems are considered. The literature is surveyed through Spring 1980.

3606 Other Materials

REFER ALSO TO CITATION(S) 68, 256, 276, 277, 329, 331, 347, 1019, 1040

827 **(BDX—613-2989) Making B-3333 cellular silicone molding compound in a laboratory model BR Banbury.** Sanders, R.S. (Bendix Corp., Kansas City, MO (USA)). Nov 1983. Contract AC04-76DP00613. 19p. NTIS, PC A02/MF A01. Order Number DE84002191.

The effects of mixing time and batch size on cellular silicone B-3333 were evaluated with a full factorial experiment. Mixing time had no influence on standard compression set, relative linear shrinkage, apparent density, load ratio, and batch dump temperature, but it did affect load deflection slightly. Batch size was shown to affect all properties significantly; in particular, large batch sizes produced high levels of compression set, apparent density, and load deflection. The optimum laboratory mixing conditions were a batch weight of 750 g and a mix time of between 4 and 10 min.

828 **(CONF-8310163—6) Thermal conductivity and expansion enhancement associated with formation of the superionic state in $SrCl_2$.** Moore, J.P.; Weaver, F.J.; Graves, R.S.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE84001966.

From 18. international thermal conductivity conference; Rapid City, SD, USA (3 Oct 1983).

A second-order phase transition in $SrCl_2$ near 1000 K produces superionic conduction and is often called the Bredig transition. Fine-grained, 99% dense, $SrCl_2$ samples containing three volume percent TiO_2 to reduce radiant transport were used to measure the differential thermal expansion coefficient (α) by push-rod dilatometry and the thermal conductivity (λ) by a radial heat flow method. Both properties show maxima near the Bredig transition. The peak α-value is over 75 x 10^{-6} K^{-1}. The data obtained from the radial heat flow method show good agreement with earlier tests at low temperatures, and the high temperature results show a local enhancement of λ if about 0.06 W/m.K. This enhancement cannot be attributed to electronic or radiant transport, but is due to a new mechanism of thermal diffusion of vacancy-anion interstitial pairs in the superionic state.

829 **(CONF-8310163—8) Thermal conductivities of $SrCl_2$ and SrF_2 from 85 to 400 K.** Moore, J.P.; Weaver, F.J.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01. Order Number DE84001979.

From 18. international thermal conductivity conference; Rapid City, SD, USA (3 Oct 1983).

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Thermal conductivity, λ, measurements on the alkaline earth compounds $SrCl_2$ and SrF_2 indicate that the λ of $SrCl_2$ is less than that of SrF_2 by a factor of 4 to 5 over the temperature range from 85 to 400°K. This difference can be related to the differences in other parameters of the two compounds. At the lower end of the temperature range, the thermal resistivities, λ^{-1}, of both materials are linear, but larger positive deviations occur at the higher end of the range. Calculated values using an equation for acoustic phonon conduction agree with the experimental values to within 30% over the entire measurement range. The positive deviations from linearity appear to be due to the effect of lattice dilation on the Debye temperatures and Gruneisen constants.

830 **(DOE/ER/10461—10) Far-infrared studies on superconductors and heat-capacity studies on liquid crystals. Final report.** Huang, C.C. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 15 Sep 1983. Contract AC02-79ER10461. 14p. NTIS, PC A02/MF A01. Order Number DE84001123.

Low temperature (2.6 K < T < 30 K) heat-capacity measurements on one transforming V_3Si sample show that the electronic heat capacity in the superconducting state is well characterized by

the weak-coupling BCS theory. Preliminary characterization of one doped ^{3}He-cooled-Ge-bolometer for far infrared radiation gave resistance $\simeq 3 \times 10^6\ \Omega$ and sensitivity $\simeq 1 \times 10^6$ V/W at 0.43 K. Finally, one quasi-adiabatic calorimeter with high resolution and versatility has been built for studying phase transitions between the mesophases in liquid crystals which have low thermal conductivity. Heat-capacity studies have been carried out in two important continuous phase transitions, i.e., smectic A (SmA) - hexatic B and SmA - smectic C (SmC). A phase with hexatic type of ordering was first found in one liquid crystal mesophase, i.e., hexatic B. Unfortunately our results on the continuous SmA-hexatic B transition lead to large critical exponents associated with heat capacity anomaly and cannot be explained by the existing theories. On the other hand, our results on one continuous SmA-SmC transition indicated the importance of retaining sixth order in the mean-field Landau free energy expansion. Our observation resolves many controversial conclusions related to the nature of SmA-SmC transition.

831 **(DOE/ER/10600—1) Studies relating to the high conductivity of graphite intercalation compounds. Final report, April 1980-September 1983.** Fischer, J.E. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). 1983. Contract AC02-80ER10600. 4p. NTIS, PC A02/MF A01. Order Number DE84001761.

For acceptor-type compounds (p-type synthetic metals), the highest conductivity coincides with a charge density $\sim 0.05q/C$, where q is the elementary charge. Thus the optimum ionic salt conductor is $C_{20}^+ A^- B^0$, where A^- are the counterions and B^0 are neutral molecules. At higher charge density, the ionic salt picture breaks down, as evidenced by C-O or C-F covalent bond formation (revealed by ESCA). These bonds act as scattering defects, reducing sigma/sub a/(300K). Further, the sigma/sub a/(T) behavior is defect-dominated up to 300K and perhaps beyond, and the reflectivity edges broaden accordingly. Given the intrinsic properties of the 2D graphite net and the dominance of graphite-derived phonons at 300K, it is concluded that all acceptor GIC's will have the same limiting conductivity 1/3 to 1/2 that of pure copper at 300K.

832 **(DOE/ER/10881—T2) Dynamic aspects of the dye-sensitized photoconductivity of semiconductors. Technical progress report.** Goncalves, A.M.P. (Temple Univ., Philadelphia, PA (USA)). 1983. Contract AC02-81ER10881. 10p. NTIS, PC A02/MF A01. Order Number DE84001132.

Our efforts have been directed along three separate lines of investigation of dyes adsorbed on semiconductor and insulator surfaces: First, direct fluorescene lifetime measurements aimed at exploring injection and the processes which compete with it. Second, fluorescence quantum yield measurements as a function of surface coverage, designed to further examine the processes competing with injection, energy transfer quenching in particular. Third, construction of a fast transient absorption spectrophotometer to probe the oxidized dye population, designed to examine the competition between recombination and escape.

833 **(DOE/ER/45023—1) Optical studies of dynamical process in disordered materials. Annual progress report, September 1, 1983-February 29, 1984.** Yen, W.M. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1983. Contract AC02-83ER45023. 5p. NTIS, PC A02/MF A01. Order Number DE84002048.

In this report, we outline progress attained during the initial period of this contract whose aim is to conduct a comprehensive study of various dynamical processes which affect the optically excited states of activated disordered and amorphous materials. During this contract period we have concluded the experimental phase of a study of nonradiative relaxation properties of Cr^{3+} in some oxide glasses and have begun a series of studies on time-resolved line-narrowed fluorescence of Yb^{3+} in silicate glasses.

834 **(IS-RIC-PR—6) Critical evaluation of binary rare earth phase diagrams. Progress report, March 1-May 31, 1983.** Gschneidner, K.A. Jr.; Calderwood, F.W. (Iowa State Univ. of Science and Technology, Ames (USA). Rare-Earth Information Center). Jun 1983. Contract W-7405-ENG-82. 54p. NTIS, PC A04/MF A01. Order Number DE84002631.

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This report is a continuation of the first five reports IS-RIC-PR-1, 2, 3, 4 and 5. It covers the crystal structures, phase diagrams, and thermodynamic properties of R-As (R = La to Lu), Sc-As, and Y-As. (DLC)

835 **(JAERI-M—82-067) Oxidation of graphites for core support post in air at high temperatures.** Imai, H.; Fujii, K.; Kurosawa, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1982. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703709.

Oxidation reactions of candidate graphites for core support post with atmospheric air were studied in a temperature range between 550°C and 1000°C. The reaction rates, temperature dependence of the rates and distribution of bulk density in the oxidized graphites were measured and the characters obtained were compared between the brand of graphites. On the basis of the experimental results, dimension and strength of the post after corrosion with air, which might be introduced in rupture accident of primary coolant tube, were discussed. In the case of IG-11 graphite, it was proved that the strength of post is still sufficient even 100 hours after the beginning of the accident and that, however, it is necessary to insert more deeply the post against graphite blocks.

836 **(JAERI-M—82-089) Characteristics of TiC and oxidation resistance and mechanical properties of TiC coated graphite under corrosive environment.** Yoda, S.; Oku, T.; Ioka, I.; Umekawa, S. (Japan Atomic Energy Research Inst., Tokyo). Jul 1982. 27p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703710.

Core region of the Very High Temperature Gas Cooled Reactor (VHTR) consists mainly of polycrystalline graphite whose mechanical properties degradated by corrosion resulting from such impurities as O_2, H_2O, and CO_2 in coolant He gas. Mechanical properties and oxidation resistance of TiC coated graphite under corrosive conditions were examined in order to evaluate the effects of TiC coating on preventing the graphite from its degradation in service condition of the VHTR. Characteristics of TiC coating was also examined using EPMA. Holding the specimen at 1373 K for 6 hr produced strong interface between TiC coating and the graphite, however, microcracks on TiC coating was observed, the origin of which is ascribed to mismatch in thermal expansion between TiC coating and the graphite. Oxidation rate of TiC coated graphite was one-third of that of uncoated graphite, which demonstrated that TiC coating on the graphite improved the oxidation resistance of the graphite. However, debonding of TiC coating layer at the interface was observed after heating for 3 to 4 hr in the oxidation condition. Changes in Young's modulus of TiC coated graphite were a half of that of uncoated graphite. Flexural strength of TiC coated graphite remained at the original value up to about 4 hr oxidation, therafter it decreased abruptly as was the trend of uncoated graphite. It is concluded that TiC coating on graphite materials is very effective in improving oxidation resistance and suppressing degradation of mechanical properties of the graphite.

837 **(LBL—15491-Rev.) Annealing of interstitial loops in arsenic implanted silicon.** Wu, N.R.; Ling, P.; Sadana, D.K.; Washburn, J.; Current, M.I. (Lawrence Berkeley Lab., CA (USA); Trilogy, Cupertino, CA (USA)). May 1983. Contract AC03-76SF00098. 13p. (CONF-830508—4-Rev.). NTIS, PC A02/MF A01. Order Number DE84000384.

From 163. Electrochemical Society meeting; San Francisco, CA, USA (8 May 1983).

The annealing effect of different gas ambient (N_2 or O_2) on high dose (5×10^{15}) As-ion-implanted Si wafer has been investigated by using transmission electronic microscope. A two-layer defect structure is observed. The lower layer defects are interstitial type and attributed to the amorphous island below original crystalline-amorphous interface. The upper layer loops are As precipitation in the form of stacking fault. By comparing the growth/shrinkage rate of interstitial loops during neutral and oxygen annealing, it is proved that interstitial silicons are injected into bulk silicon during oxidation.

838 **(LBL—16308) TEM study of ion-implanted semi-insulating gallium arsenide.** Choksi, H. (Lawrence Berkeley Lab., CA (USA)). Jun 1983. Contract AC03-76SF00098. 66p. NTIS, PC A04/MF A01. Order Number DE84001879.

Thesis.

The defect structures produced after annealing semi-insulating GaAs wafers implanted with either chromium alone, oxygen alone or both chromium and oxygen have been studied using transmission electron microscopy (TEM). A comparison was made between wafers in which the implantation was done into an initially perfect crystal and wafers that had been pre-implanted with Ga and As to produce an initially amorphous surface layer. Though the annealing was carried out at a relatively high temperature (~ 830°C), it was found that the extended defect structure after annealing depended critically on the nature of the damage produced by implantation. The previously amorphized and implanted wafers could be distinguished from the as-grown and implanted wafers: the defects in the former consisted primarily of microtwins on (111) planes whereas in the latter they consisted of dislocation networks that delineated adjacent areas of crystal slightly misoriented with respect to one another. No precipitates of the implanted species were detected.

839 **(LBL—16406) Recent studies on second-harmonic generation as a surface probe.** Tom, H.W.K.; Heinz, T.F.; Ye, P.; Shen, Y.R. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). Jun 1983. Contract AC03-76SF00098. 6p. (CONF-830666—4). NTIS, PC A02/MF A01. Order Number DE84001854.

From 6. international conference on laser spectroscopy; Interlaken, Switzerland (27 Jun 1983).

Optical second-harmonic generation (SHG) is sensitive enough to respond to a submonolayer of surface atoms or molecules. It can therefore be used to probe surfaces or interfaces between two centrosymmetric media. The surface-specific nature of this optical method offers some advantages. We have demonstrated in recent experiments that resonant SHG can allow us to obtain spectroscopic data of submonolayers of adsorbed molecules on a surface. The signal was so strong that less than one tenth of a monolayer of dye molecules could be easily detected. The method can be applied to molecules adsorbed at an interface between two dense media such as a liquid/solid interface. Then, using SHG, adsorption isotherms of adsorbates on substrates can be measured. One is often interested in how large the bulk contribution to SHG is in comparison with the surface contribution. Second-order nonlinear optical processes are forbidden in a medium with inversion symmetry only in the electric-dipole approximation. Could SGH from electric-quadrupole and magnetic-dipole contributions in the bulk be so strong as to mask out the electric-dipole contribution from the surface. We have found that the SH signal from a centrosymmetric substrate can be changed appreciably by the adsorption of a monolayer. This clearly indicates that it is the adsorbate layer rather than the bulk of the substrate which dominates the SHG process. We are, however, also interested in developing the SHG technique for studying bare surfaces, and would like to know the relative bulk and surface contribution to SHG in such cases. We have studied this problem experimentally by measuring the SHG from well-defined faces of a crystalline material.

840 **(LBL—16615) Glass-like carbon: a C/sub x/H polymer intercalation compound.** Bragg, R.H. (Lawrence Berkeley Lab., CA (USA)). May 1983. Contract AC03-76SF00098. 11p. (CONF-8305143—1). NTIS, PC A02/MF A01. Order Number DE84001863.

From 3. international conference on graphite intercalation compounds; Pont-a-Moussan, France (23 May 1983).

The structure and annealing behavior of glass-like carbon show that it is a polymer carbon but similar to other carbons that have been extensively studied. X-ray and neutron diffraction indicate a crystallite size of 2.0 to 5.0 nm, but lattice fringe images show continuous interwould laths made up of 5 to 10 layers of graphite planes. During heating above 2000°C, the interlayer spacing decreases, hydrogen is removed, and the sign of the Hall coefficient changes. It is proposed that these phenomena indicate de-intercalation of hydrogen from an intercalation compound of stage 1 composition C_3H.

841 **(N—8321989) Graphoepitaxy of GaAs on molybdenum.** Fletcher, R.M.; Wagner, D.K.; Ballantyne, J.M. (Cornell Univ., Ithaca, NY (USA)). 1982. 42p. (NASA-CR—170104). NTIS, PC A03/MF A01.

A program for investigating the grain enlargement resulting from the laser recrystallization of a thin gallium arsenide film on a patterned substrate, a technique known as graphoepitaxy was evaluated. More specifically, the effects of recrystallizing an uncapped gallium arsenide film using a continuous wave neodymium YAG laser operating at 1.06 microns were studied. In an effort to minimize arsenic loss from the film, the specimens were held in an arsine atmosphere during recrystallization. Two methods for fabricating patterned substrates were developed, one using reactive ion etching of a molybdenum film on both sapphire and silicon substates and another by preferential wet etching of a silicon substrate onto which a film of molybdenum was subsequently deposited.

842 **(N—8321991) A study of production of misibility gap alloys with controlled structures.** Parr, R.A.; Johnston, M.H.; Burka, J.A.; Davis, J.H.; Lee, J.A. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Mar 1983. 43p. (NASA-TP—2144). NTIS, PC A03/MF A01.

Composite materials were directionally solidified using a new technique to align the constituents longitudinally along the length of the specimen. In some instances a tin coating was applied and diffused into the sample to form a high transition temperature superconducting phase. The superconducting properties were measured and compared with the properties obtained for powder composites and re-directionally solidified powder compacts. The samples which were compacted and redirectionally solidified showed the highest transition temperature and wildest transition range. This indicates that both steps, powder compaction and resolidification, determine the final superconducting properties of the material.

843 **(N—8324378) XPS study of chemically etched GaAs and InP.** Bertrand, P.A. (Aerospace Corp., El Segundo, CA (USA)). Mar 1982. 26p. (AD-A—113099). NTIS, PC A03/MF A01.

The surface composition of p-type GaAs etched in HCl or Br_2 in methanol, and n-type InP etched in HCl, H_2SO_4, HNO_3 or Br_2 in methanol were studied by means of X-ray photoelectron spectroscopy (XPS). The surface compositions of GaAs and the binding energy of the surface As atoms vary with the etching solution and with the extent of oxidation of the surface. The full width at half-maximum of the Ga(3p) photoelectron peak increases upon exposure of etched GaAs to air. The XPS results are compared with Schottky barrier heights previously measured for similarly prepared surfaces with Pb contacts. The amount of oxidized P on InP surfaces is higher after an HNO_3 etch than after HCl, H_2SO_4, of Br_2/methanol treatments. An HCl etch leaves an unoxidized slightly In-rich surface.

844 **(N—8325586) Material growth and characterization for solid state devices.** Stefanakos, E.K.; Collis, W.J.; Abul-Fadl, A.; Iyer, S. (North Carolina Agricultural and Technical State Univ., Greensboro (USA)). 1983. 74p. (NASA-CR—170342). NTIS, PC A04/MF A01.

InGaAs was grown on Fe-doped (semi-insulating) (100) InP substrates by CCLPE at 640 C and current densities of 2.5 sq cm to 5 A/sq cm for periods from 5 to 30 minutes. Special efforts were made to reduce the background carrier concentration in the grown layers. The best layers exhibited carrier concentrations in the mid - 10 to the 15th power/cu cm range and up to 10,900 sq cm/V-sec room temperature mobility. InGaAsP quarternary layers of energy gap corresponding to a wavelength of approximately 1.5 micrometers were grown on (100) InP substrates by CCLPE. In all these layers, lateral edge growth was observed, possibly due to localized thermal effects at the graphite insert edges. In the device fabrication area, work was directed toward processing MISFET's using InGaAs. Silicon nitride was sputter deposited using a Si_3N_4 target in an ion beam deposition system. These sputtered layers were found to possess a high density of pinhole defects which precluded capacitance-voltage analysis. A deposition system for depositing

Al_2O_3 by the pyrolytic decomposition of aluminum isopropoxide is under construction.

845 **(SAND—83-2277C) Ion channeling analysis of GaAs/sub x/P/sub 1-x//GaP strained-layer superlattices.** Picraux, S.T.; Biefeld, R.M.; Osbourn, G.C.; Chu, W.K. (Sandia National Labs., Albuquerque, NM (USA); North Carolina Univ., Chapel Hill (USA)). 1983. Contract AC04-76DP00789. 9p. (CONF-831174—7). NTIS, PC A02/MF A01. Order Number DE84002536.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

Portions are illegible in microfiche products.

Axial ion channeling and backscattering with 2 MeV ^4He are used to probe the strain in $GaAs_{.16}P_{.84}/GaP$ strained-layer superlattices (SLS) by two methods. The tetragonal distortions in the growth direction of SLS's give rise to alternating tilts in inclined crystal directions at each interface. In the first method the large increase in dechanneling along <110> directions containing the angular tilts is measured relative to the negligible increase in dechanneling along the <100> growth direction. This method provides a sensitive depth-dependent measure of strain but requires computer simulation for quantitative analysis. In the second method, channeling angular scans are used to directly measure the lattice strain by the shift in the <110> crystal direction in the top layer relative to the average <110> direction. These results demonstrate the validity of the strain accommodation model for the interpretation of the dechanneling and indicate that GaAs/sub x/P/sub 1-x//GaP SLS structures of high crystalline quality can be obtained with strains somewhat lower than that predicted theoretically from bulk lattice properties.

846 **(TU-Inf—05-08-81) New solid-state effects used in neutron detection and dosimetry. 1.** Doerschel, B.; Hahn, G. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 1981. 9p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704267.

A review is given of radiation effects on solids and their usability for personnel neutron dosimetry. Part 1 covers mechanical effects on the crystal lattice of solids (dislocations in copper foils and changes in the bulk modulus, unclear effects in quartz connected with changes in the oscillation frequency), thermal effects of metals embedded in type I superconductors (superheated colloid detectors) or other materials (superheated drop detectors).

847 **(TU-Inf—05-09-81) New solid-state effects used in neutron detection and dosimetry. 2.** Doerschel, B.; Hahn, G. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 1981. 15p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704268.

Part 2 covers electrical effects on insulators (aluminium oxide, MOS structures, and electrets) in contact with radiators and on semiconductor storage circuits (RAMs and PROMs) including photodiodes. Utilization of magnetic and optical effects is mentioned especially with regard to emergency uses. 45 references are given.

848 **Pressure dependence of the electron capture cross section of the B hole trap in liquid phase epitaxial gallium arsenide.** Barnes, C.E.; Samara, G.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **43**: No. 7, 677-679(1 Oct 1983). Contract AC04-76DP00789.

A study of the hydrostatic pressure dependence of the electron capture cross section of the B hole trap in liquid phase epitaxial gallium arsenide has revealed that this cross section is strongly affected by pressure. The results are consistent with, and provide support for, the multiphonon emission model for the capture process at this trap.

849 **Simple method for preparing hydrogenated amorphous silicon films by chemical vapor deposition at atmospheric pressure.** Ellis, F.B. Jr.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). *Journal of Applied Physics;* **54**: No. 9, 5381-5384(Sep 1983). Contract AC02-77CH00178.

An inexpensive one-step method is presented for fabricating hydrogenated amorphous silicon (a-Si:H) films with good photovoltaic properties using chemical vapor deposition (CVD) from a mixture of polysilanes, Si/sub n/H/sub 2n/+2, in hydrogen at atmospheric pressure. This gas mixture is generated by a simple chemical reaction and used immediately in the CVD process. Thus, the highly flammable polysilanes need not be handled, distilled, stored, or transported. The conditions necessary for high (about 10%) hydrogen incorporation are explained. The method requires no expensive vacuum or electrical equipment and permits very high deposition rates (50—100 A/s). It is shown that the growth rate of the film is determined by the gas-phase chemistry and not the surface chemistry. In addition a new, safe, and economical technique for phosphorus doping is described.

850 **Thermal stability of electrically active dopants in laser annealed silicon films.** Wilson, S.R.; Paulson, W.M.; Gregory, R.B.; Tam, G.; White, C.W.; Appleton, B.R.; Rai, A.K.; Pronko, P.P. (Semiconductor Research and Development Laboratories, Motorola, Incorporated, 5005 E. McDowell Road, Phoenix, Arizona 85008). *Journal of Applied Physics;* **54**: No. 9, 5004-5013(Sep 1983). Contract W-7405-ENG-26.

Single crystal Si wafers and polycrystalline Si films on Si_3N_4 have been implanted with large doses ($1 \times 10^{15}/cm^2$—$4 \times 10^{16}/cm^2$) of P or As and laser annealed with either a cw or pulsed laser. The samples were then subjected to thermal anneals between 450 and 900 °C to determine the thermally stable dopant concentration for each sample. Sheet resistance and Hall measurements have been used to measure the electrical properties in each case. SIMS, RBS, and TEM have been used to measure atomic profiles, As substitutionality and residual defects after laser and thermal annealing. In each case the maximum electrically active dopant concentration achieved by laser annealing decreased after a 700—800 °C thermal anneal.

851 **Effects of ion-implantation damage on the first-order Raman spectra of GaP.** Myers, D.R.; Gourley, P.L.; Peercy, P.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **54**: No. 9, 5032-5038(Sep 1983). Contract AC04-76DP00789.

We have analyzed the effects of ion-implantation-induced damage on the first-order Raman spectra of GaP, and have correlated changes in the Raman spectra with direct measurements of implantation-induced surface stresses. We find that, at low ion fluences, the effects of implantation damage are to produce point defects that remove free carriers from doped material and to produce stresses in the undamaged regions. In this regime, the stress-induced shifts of the Raman lines can be predicted from the known elastic constants of undamaged GaP. At intermediate fluences, implantation damage alters the elastic properties of GaP so that the stress-induced shifts of the Raman lines are less than those predicted from the properties of the undamaged crystal. At higher doses, implantation-induced surface stresses exceed the elastic limit of the damaged material. This plastic deformation of the implanted surface is accompanied by a rapid broadening of the phonon lines in the first-order Raman spectra.

852 **Possible application of nuclear resonance fluorescence to study surface effects.** Wielopolski, L.; Vartsky, D.; Cohn, S.H. (Brookhaven National Laboratory, Medical Research Center, Upton, New York 11973). *Journal of Applied Physics;* **54**: No. 9, 5449-5450(Sep 1983). Contract AC02-76CH00016.

Observations were made of the differences between the iron nuclear resonance fluorescence yield from a gaseous $^{56}MnCl_2$ source in a clear fused quartz vial and a source in a clear fused silica (Suprasil) vial. The nuclear resonance fluorescence may be

applied to study surface effects in materials undergoing radiation damage.

853 Effects of oxygen content on pressure-induced superconductivity in $EuMo_6S_8$. Capone, D.W. II; Guertin, R.P.; Foner, S.; Hinks, D.G.; Li, H. (Tufts University, Medford, Massachusetts 02155). *Physical Review Letters;* **51**: No. 7, 601-604(15 Aug 1983).

Pressure-induced superconductivity in $EuMo_6S_8$ is sensitive to the systematic addition of oxygen. As oxygen content increases, the critical pressure above which the sample is superconducting ($P \approx 11$ kbar) decreases, the onset is less abrupt, the maximum T/sub c/ (11.8 K) decreases, and dT/sub c//dP at high pressures (-0.29 K/kbar) is less negative. The c/a ratio and the unit cell volume vary linearly with the extrapolated zero pressure T/sub c/. The results are discussed in terms of an oxygen-induced defect at the Eu site.

854 Comment on graphite intercalated with H_2SO_4. Ebert, L.B.; Appelman, E.H. (Corporate Research Science Laboratories, Exxon Research and Engineering Company, P.O. Box 45, Linden, New Jersey 07036). *Physical Review [Section] B: Condensed Matter;* **28**: No. 3, 1637-1638(1 Aug 1983).

Salaneck, Brucker, Fischer, and Metrot [Phys Rev. B 24, 5037 (1981)] have stated that x-ray-photoelectron spectroscopic data indicate that the intercalant of the graphite-sulfuric acid system consists of species containing a variety of S/sub n/O/sub 4n/ $^{2-}$ ions. We question the evidence for these peroxy sulfate species, since C_{17}^{+} can be formed at potentials 0.23 to 0.38 V below that necessary to make $S_2O_8^{2-}$. The reaction of the chemically similar SO_4F^- species with graphite yields a product which does not contain SO_4F^-, suggesting that strong chemical oxidants will not be stable with respect to graphite.

855 Neutron diffraction from ethylene adsorbed on graphite. Satija, S.K.; Passell, L.; Eckert, J.; Ellenson, W.; Patterson, H. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **51**: No. 5, 411-414(1 Aug 1983). Contract AC02-76CH00016.

A neutron-diffraction study of deuterated-ethylene overlayers on graphite basal planes reveals the existence of three distinct adsorbed solid phases as well as the coexistence of adsorbed and bulk phases at higher coverages. Evidence of a surface wetting transition involving transfer of molecules from the bulk to adsorbed phase is also obtained.

856 Random-field effects in the diluted two-dimensional Ising antiferromagnet Rb_2Co/sub 0.7/Mg/sub 0.3/F_4. Birgeneau, R.J.; Yoshizawa, H.; Cowley, R.A.; Shirane, G.; Ikeda, H. (Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] B: Condensed Matter;* **28**: No. 3, 1438-1448(1 Aug 1983).

We report a comprehensive neutron scattering study of the spin correlations in the diluted two-dimensional (2D) Ising antiferromagnet Rb_2Co/sub 0.7/Mg/sub 0.3/F_4 in an applied magnetic field. As predicted by Fishman and Aharony, an applied field in this system produces a random staggered magnetic field. Random fields are expected to have drastic effects on the cooperative behavior of magnets although the detailed behavior remains controversial. It is found that the applied magnetic field, and by inference the concomitant random staggered fields, destroy the 2D long-range order for all temperatures and fields. The structure factor S/sup z/ z(Q) = summation/sub r/e/sup i/Qxr <S/sup z//sub r/xS/sup z/ $_0$T is well described as the sum of a Lorentzian plus a Lorentzian squared with the Lorentzian-squared term dominating at low temperatures. The integrated intensity of the Lorentzian-squared term exhibits the same temperature dependence as the Bragg intensity at zero field. The correlation length κ and structure-factor peak intensity scrS/sup z/z(Q_0) exhibit power-law dependences on the applied field H, $\kappa \sim$ H/sup 1.6/, and scrS/sup z/z(Q_0)~H/sup -3.2/ at low temperatures; the measured exponents agree reasonably with the values 2 and -4, respectively, deduced from theories with the lower marginal dimensionality d/sub l/ = 3. The effective exponents initially increase slightly with increasing temperature and then decrease dramatically as T→T/sub N/, taking on values of about 0.7 and -1.2, respectively, at T/sub N/ = 42.5 K. For small but nonzero applied fields the inverse correlation length may be factorized into a random-field part and a thermal part, κ = κ/sub RF/+κ/sub T/, with κ/sub T/~ezz/k/sub B/T where J/sup z/z is the Ising exchange constant.

857 X-ray- and neutron-diffraction measurements on $BaMnF_4$. Cox, D.E.; Shapiro, S.M.; Nelmes, R.J.; Ryan, T.W.; Bleif, H.J.; Cowley, R.A.; Eibschuetz, M.; Guggenheim, H.J. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **28**: No. 3, 1640-1643(1 Aug 1983).

X-ray- and neutron-diffraction measurements on powder and single-crystal samples of $BaMnF_4$ have failed to show any evidence for the distortion with wave vector, in reciprocal-lattice units, q = (0.4, 0, 0.5) recently reported by Scott, Habbal, and Hidaka. The distorted phase which is observed below 247 K is described by a wave vector q = (zeta, 0.5, 0.5) with zeta incommensurate. There is a small (~1%) increase in the magnitude of zeta as the temperature is lowered to 100 K, and the detailed temperature dependence of zeta is found to be different on heating and on cooling. The low-temperature distortion is characterized by a single wave vector q = (zeta, 0.5, 0.5) rather than by a pair of wave vectors (zeta, 0.5, 0.5) and (zeta, -0.5, 0.5).

858 Experimental characterization of the flux-line lattice in superconducting V_3Si. Christen, D.; Chang, Y.; Kerchner, H.; Larson, B.; Narayan, J.; SeKula, S. (Solid State Div., Oak Ridge Nat'l Lab, P.O. Box X, Building 3010, Oak Ridge, Tennessee 37830). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 884-888(May 1983). Contract W-7405-ENG-26.

Several microscopic properties of the flux-line lattice (FLL) in three separate single crystals of V_3Si have been investigated by means of small-angle neutron diffraction. These low-field FLL characterizations have been correlated with the following material and superconducting properties: the real crystal symmetry parallel to the applied magnetic field; the micro-structure as determined by TEM; magnetic irreversibilities in the mixed state; reversible flux-line motion in ac response; martensitic structural transformation observed by X-ray diffraction. The three samples, V_3Si-MP3, -MP4, and -MP5 possessed different defect structures, and this was manifested foremost in the FLL perfection. At low field (B<0.2 T) and T=4.85 K, only MP3, which is free of second-phase precipitates, showed a highly resolved FLL. Sample MP5 contains a low density of small (200 A) coherent precipitates, and revealed well-defined FLL Bragg peaks for B about>0-.5 T, but a highly mosaic, nearly polycrystalline FLL at lower fields. Sample MP4 contained large (500-1000 A) incoherent precipitates, and showed only a polycrystalline FLL at low field. In both MP3 and MP5, distinct anisotropic correlations were observed between the FLL morphology and the real-crystal direction along the applied field. The FLL perfection was strongly dependent on the growth history. The peak width history dependence for two different scattering geometries can be qualitatively modeled by proposed flux-pinning mechanisms. Quantitative comparisons with critical current measurements, however, are not totally reconcilable.

859 Nanosecond resolved X-ray diffraction during pulsed laser annealing of silicon. Mills, D.M. (Cornell Univ., Ithaca, NY (USA). Cornell High Energy Synchrotron Source; Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics); Larson, B.C.; White, C.W.; Noggle, T.S. (Oak Ridge National Lab., TN (USA). Solid State Div.). *Nuclear Instruments and Methods in Physics Research;* **208**: No. 1-3, 511-517(15 Apr 1983). (CONF-820839—). Contract W-7405-ENG-26.

From International conference on X-ray and VUV synchrotron radiation instrumentation; Hamburg, F.R. Germany (9 Aug 1982).

The pulsed nature of the X-rays emitted from the Cornell High Energy Synchrotron Source (CHESS) was utilized to carry out a diffraction study of the near-surface structure and temperature of silicon following pulsed ruby laser annealing. To our knowledge, this was the first temporal X-ray diffraction investigation of a

system at the nanosecond timescale. In this paper we describe experimental details concerning the synchronization of the laser with the X-ray bursts along with a description of the data collection technique and experimental results.

860 **Optical properties of Nd^{3+} in metaphosphate glasses.** Weber, M.J. (Lawerence Livermore National Lab., CA); Saroyan, R.A.; Ropp, R.C. *Journal of Non-Crystalline Solids;* **44**: No. 1, 137-148(May 1981). Contract W-7405-ENG-48.

Absorption and fluorescence spectra and fluorescence lifetimes of Nd^{3+} ions were measured for the following polymeric metaphosphate glasses: [$M(PO_3)_3$]/sub n/, where M=Mg, Ca, Sr, Ba, Zn, Cd, and $Al(PO_3)_3$. Judd-Ofelt intensity parameters for f-f transitions were derived from the integrated absorption spectra and used to calculate the spontaneous emission probabilities from the $^4F_{3/2}$ state. Metaphosphate glasses exhibit systematic variations of refractive indices, optical intensity parameters, fluorescence lifetimes and linewidths, and stimulated emission cross sections with alkaline earth. The origin of these variations and their implications for tailoring spectroscopic properties by compositional changes are discussed. Neodymium laser action in metaphosphate glasses is also considered.

861 **Kinetics of pore coarsening in glassy carbon.** Bose, S.; Bragg, R.H. (University of California, Berkeley). *Carbon;* **19**: No. 4, 289-295(1981). Contract W-7405-ENG-48.

One third of the microstructure of glassy carbon (GC) consists of closed pores. Density measurements indicate that the total pore volume depends only on the heat treatment temperature and not on the heat treatment time, a characteristic of coarsening. The kinetics of coarsening of these pores on heat treatment has been investigated by analyzing the changes in specific surface area of the pores as determined by the small angle X-ray scattering (SAXS) technique. A part of the surface area change is due to thermal expansion induced microcracking. Both the superposition method after correcting the thermal expansion induced surface area change and the curve fitting method give an activation energy of 64 +/- 10 kcal/mole. This value is compared with the activation energies of various rate processes in graphite. A model of coarsening of the pores based on a vacancy migration mechanism is proposed.

862 **Analysis of defects in laser annealed GaAs.** Fletcher, J.; Narayan, J.; Lowndes, D.H. (Oak Ridge National Laboratory, TN). pp 421-430 of Defects in semiconductors. Narayan, J.; Tan (eds.). Amsterdam, Netherlands; North-Holland Inc. (1981). Contract W-7405-ENG-26.

The nature and depth distributions of residual damage in ion implanted and pulsed ruby laser annealed GaAs have been studied using both plan-view and cross-section transmission electron microscopy (TEM) specimens for high dose (1.0×10^{15} cm^{-2}) Zn^+, Se^+ and Mg^+ implants. It was found that laser energy densities above 0.36 J/cm^2 were required to remove the implantation damage, this threshold energy density giving good agreement with that indicated by electrical activation measurements. Laser induced surface degradation of the GaAs was present even for energy densities as low as 0.25 J/cm^2, and more severe damage, with the introduction of dislocations near the surface, was present for energy densities above 0.8 J/cm^2. The use of thin SiO_2 layers for encapsulation during laser annealing was found to substantially reduce this surface degradation.

863 **Enhanced diffusion and formation of defects during thermal oxidation.** Narayan, J.; Fletcher, J.; Appleton, B.R.; Christie, W.H. (Oak Ridge National Laboratory, TN). pp 355-365 of Defects in semiconductors. Narayan, J.; Tan (eds.). Amsterdam, Netherlands; North-Holland Inc. (1981). Contract W-7405-ENG-26.

Enhanced diffusion of dopants and the formation of defects during thermal oxidation of silicon has been investigated using electron microscopy, Rutherford backscattering, and secondary ion mass spectroscopy techniques. Enhanced diffusion of boron was clearly demonstrated in laser annealed specimens in which secondary defects were not present. In the presence of secondary defects, such as precipitates, enhanced diffusion during thermal oxidation was also observed for arsenic in silicon. The mechanisms associated with thermal-oxidation enhanced diffusion are discussed briefly.

864 **Convection and constitutional supercooling cells in laser annealed silicon.** Narayan, J.; Fletcher, J. (Oak Ridge National Laboratory, TN). pp 431-437 of Defects in semiconductors. Narayan, J.; Tan (eds.). Amsterdam, Netherlands; North-Holland Inc. (1981). Contract W-7405-ENG-26.

The formation of convection and constitutional super-cooling induced cells has been studied in indium implanted, laser annealed silicon using plan-view and cross-section electron microscopy. The convection cells were associated with the spatial inhomogeneity in the laser pulse, which leads to large temperature gradients in the lateral direction. The average size of constitutional supercooling cells decreases with increasing velocity of solidification, and it also decreases from (111) orientation to (100). The results of a perturbation theory will be discussed, which predicts the cell size and limiting concentration of instability as a function of velocity of solidification.

865 **Large stimulated emission cross section of Nd^{3+} in chlorophosphate glass.** Weber, M.J. (Lawrence Livermore National Lab., CA); Almeida, R.M. *Journal of Non-Crystalline Solids;* **43**: 99-104(1981). Contract W-7405-ENG-48.

We have investigated the spectroscopic properties of Nd^{3+} in a series of sodium chlorophosphate glasses. Glasses with 30-40 mol.% $ZnCl_2$ have the largest stimulated emission cross section for the $^4F_{3/2} \rightarrow {}^4I_{11/2}$ transition we have measured for any glass. The large cross section in this mixed anion glass is attributed to a combination of a large line strength, narrow emission bandwidth, and favorable nephelauxetic shift.

866 **EXAFS studies of metallic glasses.** Wong, J. pp 45-77 of Topics in applied physics, vol. 46: glassy metals I. Gunderodt, H.; Beck, H. (eds.). Berlin, Germany, F.R.; Springer-Verlag (Dec 1979). Contract AC02-79ER10382.

EXAFS (extended x-ray absorption fine structure) is the oscillatory modulation of the absorption coefficient on the high energy side of an x-ray absorption edge of a constituent atom in a system. This mode of spectroscopy has been realized in recent years to be a very powerful tool for probing the local atomic environment of all states of matter, particularly since the advent of very intense synchrotron radiation in the x-ray region. In this chapter the physical mechanism associated with the EXAFS phenomenon is described in light of the single scattering approximation. The use of synchrotron radiation as a light source, data analysis, and unique features of EXAFS as a structural tool are discussed. EXAFS studies on some metallic glasses are reviewed. Information derived in the dynamic disorder and local structure of both the metalloid and metal constituents in these glasses are described in some detail.

867 **Mapping of conduction bands in GaAs by angle-resolved photoemission.** Mills, K.A.; Denley, D.; Perfetti, P.; Shirley, D.A. (Lawrence Berkeley Laboratory, CA). *Solid State Communications;* **30**: 743-747(1979).

Using angle-resolved photoemission spectra in the photon energy range $12 \leq h\nu \leq 20$ eV, we have mapped selected conduction bands for the (110) direction in GaAs using a simple direct-transition analysis. At higher energies the spectra suggest a one-dimensional density of states interpretation. The two mechanisms are discussed.

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868 **(DOE/ER/10647—T1) Kinetics, mechanism and efficiency of oscillatory reactions. Final technical report, May 1, 1980-April 30, 1983.** Ross, J. (Stanford Univ., CA (USA). Dept. of Chemistry). 1 Nov 1983. Contract AT03-80ER10647. 12p. NTIS, PC A02/MF A01. Order Number DE84002424.

The project is concerned with the efficiency of thermal engines with power output, the response of oscillatory reactions to external periodic perturbations, and oscillations and control features in glycolysis. Theory predicts entrainment, resonance effects, phase locking and phase slippage.

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REFER ALSO TO CITATION(S) 1, 73, 203, 267, 293, 800, 800, 852, 936, 1116, 1117, 1175

869 **(CONF-831025—17) Isotopic measurements of uranium and plutonium by resonance-ionization mass spectrometry.** Donohue, D.L.; Young, J.P.; Smith, D.H. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001757.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Isotopic measurements of the elements uranium and plutonium have been carried out using laser-excited resonance ionization mass spectrometry (RIMS). This technique makes use of the high elemental selectivity inherent in the resonance-ionization process which results in complete removal of isobaric (same-mass) interferences. The requirements of the laser system and atomization source will be discussed with emphasis on maximizing the efficiency of temporal overlap, thus increasing the sensitivity of the technique. Results will be shown for resin-bead loaded samples containing a mixture of NBS standard reference materials of U and Pu at the nanogram level. Data will be presented which demonstrate the selectivity, accuracy, and precision of RIMS compared to the conventional thermal ionization technique.

870 **(CONF-831025—18) Heavy-ion-induced x-ray satellite emission as a chemical probe.** Rosseel, T.M.; Dale, J.M.; Hulett, L.D.; Krause, H.F.; Raman, S.; Vane, C.R.; Young, J.P. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001988.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Advances in energy technology often require correspondidng advances in materials fabrication and characterization. Among the new techniques being developed for the improved characterization of materials is an x-ray fluorescence method which uses heavy ions for excitation. High resolution measurements of heavy-ion excited x-ray spectra have revealed a series of prominent satellite lines in addition to the normal emission lines. It has been shown that these satellites display intensity variations indicative of the chemical state or environment of the emitting target atom and the projectile velocity. In order to evaluate heavy-ion induced x-ray satellite emission (HIXSE) as a chemical probe, we have examined a series of sulfur compounds and titanium, vanadium and molybdenum alloys and compounds. Results will be presented which demonstrate the chemical sensitivity of this technique, the range of elements which can be analyzed and the potential for applications to real chemical and materials problems.

871 **(CONF-831025—19) Matrix-isolation photoacoustic spectroscopy.** Shaw, R.W.; Howell, H.E.; Mamantov, G.; Wehry, E.L. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001967.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

We have recorded the first photoacoustic (PA) spectra of polycyclic aromatic hydrocarbons and n-heterocycles isolated in rare gas matrices at 5 to 10K. Matrix-isolation sampling was utilized in the hope of improving PA spectral resolution so as to provide greater analytical selectivity for the analysis of mixtures. The most sensitive transducer found was an undamped PZT disc, yielding detection limits ranging from 50 to 500 ng, depending on the molar absorptivity of the individual compound measured. Matrix isolation spectra of n-heterocycles in argon were two- to three-fold sharper than their room temperature solution counterparts. Internal and external heavy atom effects were observed for naphthalene.

872 **(CONF-8209193—1) Weak interaction studies using resonance ionization spectroscopy.** Payne, M.G.; Hurst, G.S. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE84001977.

From 9. International School of Quantum Electronics course on analytical laser spectroscopy; Erice, Italy (23 Sep 1982).

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Important developments in laser sources for the vacuum ultraviolet (VUV) region of the spectrum are making it possible to carry out resonance ionization of some of the noble gases. It has already been shown that xenon can be ionized in a two-photon allowed excitation from the ground state. Recently a new method of generating radiation by four-wave mixing in mercury vapor enables excitation of xenon in a one-photon resonance process. With these new laser sources we expect to have effective ionization volumes of 10^{-3} to 10^{-2} cm^3 for the cases of argon, krypton, and xenon. This has important consequences in weak interaction physics and environmental research.

873 **(CONF-8209193—2) Theory of resonance ionization spectroscopy.** Payne, M.G.; Hurst, G.S. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE84001975.

From 9. International School of Quantum Electronics course on analytical laser spectroscopy; Erice, Italy (23 Sep 1982).

Resonance Ionization Spectroscopy (RIS) can be defined as a state selective detection process in which pulsed tunable lasers are used to promote transitions from the selected state of the atoms or molecules in question to higher states, one of which will be ionized by the absorption of another photon. At least one resonance step is used in the stepwise ionization process, and it has been shown that the ionization probability of the spectroscopically selected species can nearly always be made close to unity. Since measurements of the number of photoelectrons or ions can be made very precisely and even one electron (or under vacuum conditions, one ion) can be detected, the technique can be used to make quantitative measurements of very small populations of the state-selected species.

874 **(CONF-8209193—3) One-atom detection and statistical studies with resonance ionization spectroscopy.** Payne, M.G.; Hurst, G.S. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE84001942.

From 9. International School of Quantum Electronics course on analytical laser spectroscopy; Erice, Italy (23 Sep 1982).

To learn how to take matter apart atom-by-atom and to count each atom according to its type, regardless of its initial chemical or physical state, is presumably a worthy goal in scientific research. The advent of the laser created real hope that these aspirations will be realized. The counting of atoms is not merely an intellectual exercise set apart from real-world applications. On the contrary, even though the capability is scarcely more than five years old, practical applications have been made in many fields of chemistry, physics, the environment, and industry. In this lecture we wish to review how the laser made possible the counting of atoms and how this capability has been put to use in situations where atoms are free to react chemically as they diffuse through a medium. Fluctuation phenomena and statistical mechanics can also be examined in these situations.

875 **(CRN-PN—82-23) Investigation into the possibility of using short silver half-lives for the determination of silver in nuclear emulsions.** Guazzoni, P.; Laverlochere, M.; Heilmann, C.; Jung, M.; Francois, H. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1982. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703684.

The 24 s and 2.4 mn short half-life Ag^{110} and Ag^{108} isotopes were used to determine the quantity of silver remaining in developed nuclear emulsions after exposure to various neutron and gamma radiations. The test carried out should lead to the development and construction of automatic measurement equipment.

876 **(DP-MS—83-37) In-line analyzer for monitoring gas composition in tritium-purification processes: design.** Chastagner, P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 13p. (CONF-831025—7). NTIS, PC A02/MF A01. Order Number DE84001419.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

At the Savannah River Laboratory, we designed and contracted for the construction of an in-line analyzer to monitor impurity concentrations ≧ 10 ppM in tritium purification processes. We are particularly interested in the immediate detection of air in-leakage or impurity buildup in the feed lines to thermal diffusion columns and to cryogenic stills. Air in-leakage could cause formation of a mixture that would explode in the thermal diffusion columns and air or other gases would freeze in the cryogenic stills and their associated piping (Table 1). The analyzer, Figure 1, consists of a specially-designed continuous sampling system, a conventional quadrupole mass spectrometer, a sealed pumping system, and a computer. The analyzer is required to operate unattended 24 hours per day at a rate of one sample point every 1.5 minutes. Complete analyses for each component in the mass 2 to 44 amu range are required at each sample point. The sample size is limited to 1 $cm^3 min^{-1}$ because tritium is a valuable material. Design constraints for the analysis system are given in Table 2.

877 **(DP-MS—83-40) On-line uranium determination using remote fiber fluorimetry.** Malstrom, R.A.; Hirschfeld, T. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Lawrence Livermore National Lab., CA (USA)). 1983. Contract AC09-76SR00001. 18p. (CONF-831025—5). NTIS, PC A02/MF A01. Order Number DE84001411.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

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An analytical technique has been developed for the remote, on-line measurement of uranium. The technique, Remote Fiber Fluorimetry, has four major components: a laser, an optical fiber, an optrode, and a detector. Since the laser and detector can be remote from the sampling point, this technique is well suited for analysis in hazardous or inaccessible environments. The application of the technique to on-line uranium analysis in a nuclear fuel processing facility at the Savannah River Plant is described. Laboratory experiments have been made to determine the effects of nitric acid, temperature, and quenchers. Preliminary experiments in a mock-up of the sampling system used in the radiochemical separations buildings are discussed.

878 **(DP-MS—83-51) Determination of uranium in plutonium solutions by laser-induced fluorescence.** Young, J.E.; Deason, P.T. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 9p. (CONF-831025—8). NTIS, PC A02/MF A01. Order Number DE84001418.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

A highly sensitive method for determining uranium in plutonium solutions has been developed at the Savannah River Plant. It uses a pulsed nitrogen laser as an excitation source for a time-resolved fluorimetric measurement. Since the sample matrix contains large quantities of fluorescence quenchers, sample purification is necessary to achieve 1 part-per-billion sensitivity. Liquid-liquid solvent extration is used to separate uranium from the sample matrix into a fluorescene-enhancing solution. The method has been successfully applied to PUREX process streams with a precision of +- 13% (95% C.I.) with volumetric transfers.

879 **(DP-MS—83-67) General-purpose chemical analyzer for on-line analyses of radioactive solutions.** Spencer, W.A.; Kronberg, J.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 12p. (CONF-831025—6). NTIS, PC A02/MF A01. Order Number DE84001417.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

An automated analyzer is being developed to perform analytical measurements on radioactive solutions on-line in a hostile environment. This General Purpose Chemical Analyzer (GPCA) samples a process stream, adds reagents, measures solution absorbances or electrode potentials, and automatically calculates the results. The use of modular components, under microprocessor control, permits a single analyzer design to carry out many types of analyses. This paper discusses the more important design criteria for the GPCA, and describes the equipment being tested in a prototype unit.

880 (IAEA-SR—72, pp 280-306) **Home-made carbonaceous adsorbents for the iodine filter.** Oglaza, J. (Institute of Nuclear Research, Warsaw (Poland)); Krzesniak, J.W. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/29).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

Assuming, that at the moment, an activated charcoal is the most widely used adsorbent in off-gas cleaning systems for elemental iodine removal, it was analyzed how to improve the adsorption properties of this filter material for removing the organic iodine compounds, especially in the presence of high relative humidity. Three different indigenous activated charcoals were selected for studies: two kinds of charcoal, designated as type A and N, as well as the charcoals used for flue gas desulfurization, as the third type S. These charcoals were impregnated with tin iodide (SnI_2), potassium iodide (KI) and triethylenediamine (TEDA). Considering the results of the laboratory tests of the efficiency methyl iodide retention by the impregnated charcoals, it was concluded, that the carbonaceous adsorbent containing 1+1.5% KI showed efficient retention of the methyl iodide (CH_3I), compared with, for example, foreign activated charcoals, as, NORIT-CGI 1% KI (West Germany) and GA^{-1} 0.5% KI (Czechoslovakia).

881 (IAEA-SR—72, pp 178-205) **Removal of gaseous radioiodine with solid adsorbents.** Wilhelm, J.G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/14).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

In nuclear power plants only activated impregnated carbon is used to remove airborne radioiodine from exhaust air and off-gas. In reprocessing plants mostly wet washing processes are used for iodine removal. As solid iodine adsorbents, only silver containing materials have been qualified for cleaning the reprocessing off-gases which are poisoned with NOsub(x). Iodine filters with impregnated activated carbon can be designed for removal efficiencies of 99.99% for elemental iodine and 99% for methyl iodide (a typical airborne organic iodine compound) under the most unfavorable operational conditions. From the operational experience it can be concluded that a high bed depth (for example 20-50 cm) together with a residence time of about 1 s will ensure a high performance (>= 99% for $CH_3{}^{131}I$) and a reasonable time of operation (approx.= 1 a) of a well designed iodine filter with impregnated activated carbon as the adsorbent.

882 **(IPEN-Pub—44) Use of tetracycline as complexing agent in radiochemical separations. A review of work done at IPEN.** Saiki, M.; Nastasi, M.J.C.; de Lima, F.W. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1982. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703699.

A review of the work carried out in the 'Instituto de Pesquisas Energeticas e Nucleares' on the use of tetracycline for analytical purposes in solvent extraction procedures is presented. Individual extraction curves for the lanthanides, zinc, scandium, thorium, neptunium and protactinium were obtained. Separations of those elements one from another, and of uranium from selenium, bromine, antimony, barium, tantalum and tungsten were carried out.

883 **(JAERI-M—82-053) Preparation and certification of a uranium isotope certified reference material JAERI-U5.** Tamura, S.; Hashitani, H. (eds.). (Japan Atomic Energy Research Inst., Tokyo). Jun 1982. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703686.

The Committee on Analytical Chemistry of Nuclear Fuels and Reactor Materials, JAERI had planned to prepare a new reference material, JAERI-U5 for uranium isotopic measurement since 1978. The reference material is composed of 6 samples of different enrichment in the range of 0.2 to 4.5 wt. percents of ^{235}U. The preparation includes dissolution of raw materials, blending of solutions, precipitation of ammonium diuranate, drying and ignition to U_3O_8. A mass-spectrometric collaborative analysis was carried out by well-trained two laboratories in this country, JAERI and PNC. The certified values were decided from the result of the collaborative work. As the measurements were based on NBS SRM's, JAERI-U5 should be called tertiary standard. The materials are packed in bottles of low-potassium-content glass for a possible use in non-destructive gamma-rays spectrometry. The reference material has been distributing from JAERI with a price of yen 140,000 per set (6 samples of 2 g of each) since 1979.

884 **(JAERI-M—82-070) Isotope-dilution mass-spectrometric analysis of boron in highly-irradiated U-Al-B alloy fuel-element specimens.** Tamura, S.; Toida, Y.; Yonezawa, C.; Tamura, K. (Japan Atomic Energy Research Inst., Tokyo). Jul 1982. 17p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703687.

Analytical procedures for determining boron contents and boron isotopic compositions in highly-irradiated U20-Al80-B0.05 alloy fuel specimens were investigated. Sample specimens(0.3g, 0.1 Ci) were decomposed in 10 ml of 1.8 M sulfuric acid. The aliquoted solutions were used to determine boron contents by isotope-dilution mass-spectrometry, to measure isotope ratios of boron, and to evaluate the burnup by ^{137}Cs method and $^{235}U/^{238}U$ isotopic ratio method. Chemical-separation procedures included separation of Al and U by precipitating with aqueous ammonia, the anion exchange (batch technique) of boron by using a boron-specific resin (IRA-943) and methyl borate distillation. Recoveries of boron in the separation procedures were checked. Decontamination factors for total gamma-ray radioactivities, for ^{137}Cs and ^{106}Ru (^{106}Rh) were observed in detail. Inhomogeneity of boron content in pre-irradiated analogous fuel-element specimens was regrettably found.

885 **(JINR—18-82-245) Highly sensitive nuclear-physical methods for Ni and Co content analysis of ferrous laterites with previous chemical treatment of samples.** Rubio, D.; Ehsteves, Kh.; Brukhertzajfer, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of Radiation Safety). 1982. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703688.

Simple and highly sensible nuclear-physical methods were developed for Ni and Co analysis in ferrous laterites with previous chemical treatment of samples. Concentrated fluorhydric acid was used for sample treatment. Separation of Ni and Co from Fe and other elements was made using cationic exchange resins in 1N HF. Further separation of Ni from Co was made with anionic exchange resins in 9N HCl. For exciting x-ray fluorescence of the elements ^{71}Ce and ^{109}Cd sources were used; and for the samples activation photo-neutrons and bremsstrahlung from a microtron were used. Sensitivity limits were obtained of approximately 0.0001% for Ni and Co by x-ray fluorescence method; approximately 0.00005% for Co by neutronic activation analysis; and approximately 0.0015% for Ni by gamma activation analysis. The measurement time was 20 min.

886 **(KFK—3531) Determination of Pu-241 by liquid scintillation counting in the environment of the Karlsruhe Nuclear Research Center.** Godoy, J.M.; Schuettelkopf, H.; Pimpl, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Apr 1983. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83751314.

A procedure was developed to measure Pu-241 by liquid scintillation counting. Sample preparation was performed by electroplating of plutonium on stainless steel planchets. To correct the selfabsorption the linear dependence of counting efficiency in the liquid scintillation counter and the resolution in the α-spectrometer was used. The determination of Pu-238, Pu-239+240 and Pu-241 was performed in soil and plant samples and in depth profiles in soil in the second main-wind direction as measured near the WAK. The dilution of plutonium isotopes in the River Old Rhine was measured until 13.5 km downstreams from the release of liquid effluents of the Karlsruhe Nuclear Research Center. The Pu-241 concentrations in soil ranged from <80 until 35000 fCi/g dry. In plant values up till 8100 fCi/g dry were measured. In the River Old Rhine the Pu-241 concentrations were between <110 and 16.200 fCi/l. The activity ratios Pu-241/Pu-239+240 in soil samples were about 12 near the WAK and about 61 in larger distances. The first value agrees very well with the ration expected in plutonium from nuclear weapon fallout. The higher value represents an additional contamination by nuclear installations. The mean value in plants was 33 and in the River Old Rhine 56. The standard deviations of the measured activity ratios are very large. The dose exposure of the environmental population of the Karlsruhe Nuclear Research Center caused be released Pu-241 is negligible low.

887 **(KFK—3532) Determination of Ra-228 by counting Cerenkov radiation caused by Ac-228.** Godoy, J.M.; Schuettelkopf, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Apr 1983. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751331.

After radiochemical cleaning of radium, a solution with sodium salicylate as wavelength-shifting compound is measured. The chemical yield is determined using barium carrier. With high counting efficiency a lower detection limit of 0.44 pCi/sample can be achieved, using a counting time of 1000 min. Disturbances by Ra-226 and Ra-224 can be prevented by simple means. The application of the method to standard samples and the comparison with other methods demonstrated good results.

888 (KFKI—1983-21, pp 127-158) **Normal coordinate treatment of liquid water and calculation of vapor pressure isotope effects.** Gellai, B. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics); Van Hook, W.A. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Mar 1983. NTIS (US Sales Only), PC A09/MF A01.

In Collection of scientific papers in collaboration with Joint Institute for Nuclear Research, Dubna, USSR and Central Research Institute for Physics, Budapest, Hungary. Algorithms and programs for solution of some problems in physics.

A vibrational analysis of liquid water is reported, assuming a completely hydrogen-bonded network with continuously varying strengths of the hydrogen bonds. Frequency distribution calculations are made for intramolecular stretching and bending modes and for the intramolecular frequency region. The calculated distributions are compared with the experimental spectroscopic ones. As another test, vapor pressure isotope effects are calculated from the theoretical distributions for some isotopic water molecules. Results are compared with those of other authors obtained from a mixture model.

889 **(LA-UR—83-2665) Approach to single-molecule detection by laser-induced fluorescence.** Dovichi, N.J.; Martin, J.C.; Jett, J.H.; Trkula, M.; Keller, R.A. (Los Alamos National Lab., NM (USA); Wyoming Univ., Laramie (USA). Dept. of Chemistry). Aug 1983. Contract W-7405-ENG-36. 4p. (CONF-830874—29). NTIS MF A01. Order Number DE84001338.

From 27. annual international technical symposium on high speed photography, videography and photonics; San Diego, CA, USA (21 Aug 1983).

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A sheath flow cuvette was evaluated in laser-induced fluorescence determination of aqueous rhodamine 6G. A detection limit of 18 attograms was obtained within a one-second signal integration time. The concentration detection limit was 8.9×10^{-14} mole per liter. An average of one-half rhodamine 6G molecule was present within the 11 pL excitation volume. However, during the signal integration time a total of 22,000 analyte molecules passed through the excitation in a 0.42 microliter volume.

890 **(LA-UR—83-2905) Considerations for the installation of an inductively coupled plasma for the analysis of radioactive samples.** Apel, C.T.; Gallimore, D.L. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 6p. (CONF-831025—14). NTIS, PC A02/MF A01. Order Number DE84001869.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The sensitivity, dynamic range, and sample through-put rate attributes of the inductively coupled plasma (ICP) call for its consideration as the instrument of choice for the multielement analysis of radioactive samples. Based on our experience in handling radioactive materials, considerations are presented concerning safety of the operator, modularity of the ICP-atomic emission spectrometer systems, reduction of the complex actinide spectra, atomization systems, drain and recovery systems, aerosol containment, heat dissipation, radiolysis effects of sample on dry-box environment, and liquid and solid sampling.

891 **(LA-UR—83-2970) Controlled-potential-coulometric determination of uranium at a platinum electrode.** Saponara, N.M.; Jackson, D.D. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-831025—15). NTIS, PC A02/MF A01. Order Number DE84001710.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

A controlled-potential-coulometric method has been developed for determining uranium at a solid electrode which features high specificity and a precision of 0.1% relative standard deviation at the 5 mg uranium level. Uranium and added iron, necessary for the electrolytic oxidation of uranium, are reduced to U(IV) and Fe(II) with excess Cr(II). At a sequence of controlled potentials, the excess Cr(II) is oxidized to Cr(III), Fe(II) and U(IV) are oxidized to Fe(III) and U(VI), then the Fe(III) is reduced to Fe(II). The difference in the measured number of coulombs for the oxidation of Fe(II) and U(IV) and for the reduction of Fe(III) to Fe(II) is proportional to the quantity of uranium.

892 **(LA-UR—83-3010) Prospects for single-molecule detection in liquids by laser-induced fluorescence.** Trkula, M.; Keller, R.A.; Martin, J.C.; Jett, J.H.; Dovichi, N.J. (Los Alamos National Lab., NM (USA); Wyoming Univ., Laramie (USA). Dept. of Chemistry). 1983. Contract W-7405-ENG-36. 4p. (CONF-831025—16). NTIS, PC A02/MF A01. Order Number DE84001702.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

A laser-induced fluoresence determination of aqueous solutions of rhodamine 6G resulted in a detection limit of 18 attograms, or 22,000 molecules, of rhodamine 6G. These results allow the projection to single-molecule detection with reasonable improvements in the experimental apparatus.

893 **(MINTEK-M—34) Determination, by atomic-absorption spectrophotometry using electrothermal atomization, of platinum, palladium, rhodium, ruthenium, and iridium.** Haines, J.; Robert, R.V.D. (Council for Mineral Technology, Randburg (South Africa)). 28 May 1982. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703689.

A method that involves measurement by atomic-absorption spectrophotometry using electrothermal atomization has been developed for the determination of trace quantities of platinum, palladium, rhodium, ruthenium, and iridium in mineralogical samples. The elements are separated and concentrated by fusion, nickel sulphide being used as the collector, and the analyte elements are measured in the resulting acid solution. An organic extraction procedure was found to offer no advantages over the proposed method. Mutual interferences between the five platinum-group metals examined, as well as interferences from gold, silver, and nickel were determined. The accuracy of the measurement was established by the analysis of a platinum-ore reference material. The lower limits of determination of each of the analyte elements in a sample material are as follows: platinum 1,6μg/l, palladium 0,2μg/l, rhodium 0,5μg/l, ruthenium 3μg/l, and iridium 2,5μg/l. The relative standard deviations range from 0,05 for rhodium to 0.08 for iridium. The method, which is described in detail in the Appendix, is applicable to the determination of these elements in ores, tailings, and geological materials in which the total concentration of the noble metals is less than 1g/t.

894 **(MINTEK-M—39) Use of masking agents in the determination, by hydride generation and atomic-absorption spectrophotometry, of arsenic, antimony, selenium, tellurium, and bismuth in the presence of noble metals.** Kellerman, S.P. (Council for Mineral Technology, Randburg (South Africa)). 16 Jul 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703690.

The effectiveness of thiosemicarbazide, tellurium, and potassium iodide as masking agents to eliminate interferences was assessed. Thiosemicarbazide was found to be effective in eliminating or reducing the interferences on arsenic, antimony, and bismuth, and tellurium reduced the interferences on selenium. The interferences on tellurium could not be eliminated. Arsenic, antimony, selenium, and bismuth were determined in metal sulphide concentrates that were spiked with the noble metals (defined here as gold plus all the platinum-group metals except osmium). The relative standard deviations for arsenic, antimony, bismuth, and selenium were 0,061, 0,017, 0,029, and 0,145 respectively. The values obtained for all the analytes agreed favourably with the preferred values for two in-house reference samples. The laboratory method is detailed in an appendix.

895 **(MINTEK-M—40) Use of X-ray-fluorescence spectrometry in the determination of uranium, cobalt, and sulphur in materials from mine dumps.** Balaes, A.M.E.; Jacobs, J.J.; Flynn, E. (Council for Mineral Technology, Randburg (South Africa)). 24 Sep 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703691.

A pressed-powder method has been developed for the determination of uranium and cobalt in samples taken from mine dumps. Prior to milling, the samples are mixed with a binder in a ratio of 9:1. Firmly bonded briquettes can be pressed without the use of a reinforcing backing or an aluminium cup. The precision of the method for U_3O_8 is 7 and 0,9 per cent at concentrations of 16 and 387 p.p.m. respectively, and for cobalt it is 0,86 per cent at a concentration of 510 p.p.m. In an assessment of the accuracy of the method, the results for U_3O_8 were compared with those determined by other methods involving X-ray-fluorescence spectrometry. The results for cobalt were compared with those obtained by atomic-absorption spectrophotometry and colorimetric methods. The lower limits of detection are 4 p.p.m. for cobalt and 2 p.p.m. for uranium. The lower limits of determination in the samples taken from mine dumps are 13 p.p.m. of cobalt and 4 p.p.m. of U_3O_8.

896 **(MINTEK-M—44) On-line dilution system for spectrometry using an inductively coupled plasma source.** Moore, G.L.; Watson, A.E.; Humphries-Cuff, P.J. (Council for Mineral Technology, Randburg (South Africa)). 6 Aug 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703692.

An on-line dilution system that uses a two-channel peristaltic pump to feed a GMK Babington type of nebulizer is described. By the use of a diluent containing the appropriate concentrations of acid, sodium, and internal standard element, which was fed at a constant rate to the nebulizer, the system produced analytical results that are not significantly different (less than 3 per cent relative) from those obtained with the normal dilution technique. However, a considerable saving in time is achieved, as well as a saving in the use of expensive reagents.

897 **(MINTEK-M—47) Separation of trace elements from iron, and the analysis of iron-rich ores for use as reference materials.** Jones, E.A. (Council for Mineral Technology, Randburg (South Africa)). 12 Aug 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703693.

Iron(III) chloride is separated from the trace elements in iron ores. After dissolution of the sample, the iron in 6M hydrochloric acid solution is separated, by liquid-liquid extraction with

methyl isobutyl ketone, from the alkali metals, alkaline earth metals, lead(II), aluminium(III), titanium(IV), chromium(III), nickel(II), copper(II), cobalt(II), manganese(II), and zinc(II). After concentration of the aqueous phase by evaporation, the trace elements are measured by the use of atomic-absorption spectrophotometry or direct-reading spectrometry with excitation from an inductively coupled plasma source, or both. The separation procedure is rapid, resulting in reduction of the time required for analysis by the direct method, because only a limited number of dilutions are necessary, and the method of additions is not needed to compensate for interferences from the iron. The extractions of chromium(III), copper(II), nickel(II), strontium(II), rubidium(I), cobalt(II), manganese(II), zinc(II), barium(II), lead(II), aluminium(III), and titanium(IV) are at least 96 per cent.

898 **(MINTEK-M—67) Determination of total cyanide in solutions containing uranium and gold.** Solomons, M.; Dixon, K. (Council for Mineral Technology, Randburg (South Africa)). 3 Jan 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703695.

This report gives the results of a limited investigation of three distillation procedures and their variants for the separation of cyanide. The spectrophotometric measurement, which follows the distillation, uses either a mixture of pyridine and pyrazolone, or a mixture of pyridine and barbituric acid. It was found that the method published in the South Africa Government Gazette in 1969 gives quantitative recoveries from potassium cyanide solutions but not in the presence of gold. The ligand-displacement method did not give quantitative recoveries in the presence of gold, except when zinc was added to the distilland, and it then failed to give a quantitative recovery of cyanide from ferrocyanide. These two methods were therefore rejected as unsuitable for the determination of cyanide in solutions containing small amounts of uranium and gold. The procedure of the American Public Health Association (APHA) was found to give quantitative recoveries in the presence of gold, uranium, thiocyanate, and ferrocyanide when cuprous chloride, or cuprous chloride with magnesium chloride, are added to the distilland. The spectrophotometric measurement using a mixture of pyridine and barbituric acid is preferred. The calibration range of the method is 0,5 to 6μg of cyanide, and the limit of determination is 0,04μg/cm³. (The relative standard deviation of the method is 0,05.) The distillation time in the APHA method is approximately two and a half hours; with 3 distillation trains, up to 9 distillations can be made per day, plus a further 2 hours for the spectrophotometric determination. The preferred laboratory method is detailed in an appendix.

899 **(NIM—2134D) On-line analysis, by x-ray diffraction, of fluorspar-containing slurries.** De Villiers, J.P.R. (National Inst. for Metallurgy, Johannesburg (South Africa)). 30 Sep 1981. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703696.

An on-line instrument developed by the National Institute for Metallurgy was used in a feasibility study on the applicability of X-ray diffraction to the analysis of fluorspar-containing slurries. The instrument is shown to have adequate sensitivity and resolution for the purpose, and further testwork is recommended.

900 **(NIM—2135D) Preliminary on-line analysis, by x-ray diffraction, of pyrite-containing slurries.** De Villiers, J.P.R. (National Inst. for Metallurgy, Johannesburg (South Africa)). 30 Sep 1981. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703697.

An on-line instrument, which was developed by the National Institute for Metallurgy, was used in a feasibility study on the applicability of X-ray diffraction to the analysis of the pyrite content of flotation concentrates from the gold-mining industry. The instrument is shown to have adequate sensitivity and resolution for the purpose, provided that the slurries are diluted. Further testwork is recommended, particularly if the analysis of layer silicates such as pyrophyllite is intended. Problems due to blockages in the transport of samples also require attention.

901 **(PNL-SA—11189) Atomic-beam density determination from laser-induced fluorescence interval distributions.** Warner, R.A.; Bushaw, B.A.; Kaye, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 6p. (CONF-8308114—2). NTIS, PC A02/MF A01. Order Number DE84000677.

From Laser-based ultrasensitive spectroscopy and detection V conference; San Diego, CA, USA (23 Aug 1983).

A resonance fluorescence method is demonstrated whereby the density of an atomic beam can be determined reliably. This determination is based on the distribution of time intervals between detected photons, and is made without independent knowledge of excitation cross sections, laser beam intensity, or photon counting efficiency.

902 **(PNL-SA—11435) Irradiation and gamma-ray spectrometric parameters for ^{129}I neutron-activation analysis.** Brauer, F.P.; Strebin, R.S. Jr.; Mitzlaff, W.A.; Kaye, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 9p. (CONF-831025—3). NTIS, PC A02/MF A01. Order Number DE84001040.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

This paper describes the influence of reactor neutron irradiation facilities on low-level ^{129}I analysis methodology. Three reactors are compared - the HFIR at ORNL, the N-Reactor at Hanford, and a 1-MW research reactor at Washington State University, Pullman, WA. Parameters compared include sensitivity for ^{129}I and natural iodine and interference effects due to high levels of ^{127}I in irradiated samples. Selection of detector systems for off-site use at HFIR is discussed. A comparison of neutron activation analysis with other sensitive detection methods for measurement of ^{129}I is given.

903 **(Y/DK—344) Results from a capillary gas chromatography: Fourier transform infrared spectrometry experiment.** Howell, R.L.; Smyrl, N.R.; Davis, W.E.; Adams, T.T. (Oak Ridge Y-12 Plant, TN (USA)). 4 Nov 1983. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE84002419.

An experiment is described in which a flow-through GC-FTIR gas cell (light-pipe) designed for capillary GC columns was installed in a Digilab Model 15C Fourier transform infrared spectrometer. Results of a test-mixture injection are presented with sensitivity and resolution data. The overall performance is discussed and improvements in design and equipment are suggested.

904 **Characterization of and correction for memory effects produced by pneumatic nebulizers in inductively coupled plasma emission spectroscopy.** Dobb, D.E.; Jenke, D.R. (Department of Chemistry and Geochemistry, Montana College of Mineral Science and Technology, Butte, Montana 59701). *Applied Spectroscopy;* 37: No. 4, 379-384(Jul 1983). Contract AC07-78ET10816.

Memory effect or sample carry over characteristics of five pneumatic nebulizers routinely used for sample introduction into plasma emission spectrometers are studied. It is observed that the primary source of the memory noted for the nebulizers studies is the dissipation rate of the fog produced by the nebulizer during introduction of the previous sample or samples. Contributions to memory from the aspiration tube, salt deposition at the nebulizer tip, and a chromatographic effect at the torch tip are minimal. In terms of operational stability, detection capability, tolerance for particulates, and low memory, a concentric nebulizer with a Pt:Ir needle, Teflon nose cone, and an extended spray director is superior to the others tested. Even under the most optimum conditions, the washout time required to reduce sample emission to 0.1% of its maximum intensity varies from 2 to 4 min, thereby greatly increasing per sample analysis time. The memory effect phenomena can be accurately modeled by a hyperbolic curve and can, therefore, be easily corrected for in routine analysis. The memory correction value, which is subtracted from a sample;s net emission intensity, is calculated from the product of an empirically defined correction constant and the emission intensity of previously run samples divid-

ed by the washout time. Examples of the utilization of the correction are shown.

905 **Analysis of aluminium by inductively coupled plasma-atomic emission spectroscopy.** Barnes, R.M.; Fernando, L.; Shang Jing, L.; Mahanti, H.S. (Department of Chemistry, GRC Towers, University of Massachusetts, Amherst, Massachusetts 01003-0035). *Applied Spectroscopy;* **37**: No. 4, 389-395(Jul 1983). Contract AC02-77EV04320.

Inductively coupled plasma-atomic emission spectroscoy (ICP-AES) is applied in the determination of 21 elements in primary refined, and alloy aluminium. Rapid and reliable sampel preparation procedures are developed. Spectral lines are selected after examination of experimental wavelength scans at each analyte wavelength. The limits of detection, background equivalent concentration, and analytical figures of merit are determined. For high silicon-containing aluminum, HF solutions were analyzed by employing an inert nebulizer utilizing polytetrafluoroethylene (PTFE) capillary tubes, an PTFE spray chamber, and an ICP torch with a graphite injector tube.

906 **Comparative determination of bromine and iodine in three air sampling media via instrumental thermal and epithermal neutron activation analysis.** Gladney, E.S.; Sedlacek, W.A. (Los Alamos National Lab., NM (USA)); Berg, W.W. (National Center for Atmospheric Research, Boulder, CO (USA)). *Journal of Radioanalytical Chemistry;* **78**: No. 1, 213-225(1983).

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A comparative determination of bromine and iodine in three distinct air sampling media by instrumental thermal and epithermal neutron activation analysis is presented. Open ocean air samples from the mid-Atlantic region were collected on ultra-pure nylon, Nuclepore, and activated charcoal substrates. The bromine and iodine content of each substrate was determined by both epithermal and thermal activation techniques. Good agreement was found within most thermal-epithermal pairs. Relative to thermal activation procedure, the epithermal technique yields peak/background ratio improvements ranging from a factor of 1.30 to 9.5. Nylon substrates showed the smallest improvement at 1.30 and both Nuclepore and activated charcoal substrates showed improvement factors of 6.7 and 9.5 for bromine and iodine, resp.

907 **Gas-solid chromatography of methane-helium mixtures: moment analysis of breakthrough curves.** Huang, J.; Rothstein, D.; Wu, B.; Madey, R. (Kent State University, OH). *Separation Science and Technology;* **17**: No. 12, 1417-1424(1982).

A moment analysis method is suggested for calculating parameters of a breakthrough curve generated from a step change of concentration of an adsorbate. The longitudinal diffusion coefficient and the solid-phase diffusion coefficient are determined from the calculated moment. A criterion is given for assessing the relative importance of the longitudinal diffusion coefficient and the solid-phase diffusion coefficient. This criterion also serves as a guide for choosing experimental parameters to determine the solid-phase diffusion coefficients.

908 **(DP-tr—51) Theory of counter-current extraction. V. Verification of formulas for calculation of the number of extraction stages.** Baoguo, L.; Yaming, N.; Guangxian, X. Translated from *Xiyou Jinshu ;* **1**: No. 2, 23-30(1982). Contract AC09-76SR00001. 12p. NTIS, PC A02/MF A01. Order Number DE84002636.

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This paper uses an electronic computer to simulate countercurrent experiments and utilizes a stage by stage calculation method to verify the formulas for calculation of the number of stages in cross-current extraction theories I and II. The results show that in a system with a constant mixture extraction ratio, the formulas for the number of stages are suitable in countercurrent technical designs.

909 **(NP-tr—3901768) Determination of ultralow radium-226 concentrations in water.** Wicke, A.; Postendoerfer, J. Translated from *Journal of Radioanalytical Chemistry ;* **56**: No. 1-2, 105-112(1980). 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83901768.

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The method used to measure the radium-226 content of drinking water down to 0.01 $pCi.l^{-1}$ was the emanation method combined with scintillation chambers, as proposed by Lucas. Results on 205 public water samples show a median value of 0.11 $pCi.l^{-1}$, and mineral waters have a median value of 1.7 $pCi.l^{-1}$. (DLC)

910 **Resolution of photographic emulsions at low electron exposure.** Downing, K.H. (Lawrence Berkeley Laboratory, CA). pp 126-127 of 37. proceeding of the electron microscopy Society of America. Bailey, G.W. (ed.). San Antonio, TX; Electron Microscopy Society of America (1979).

In recording images of radiation sensitive specimens a tradeoff must be made between resolution and noise in the image, determined essentially by magnification and exposure levels. The magnification must be high enough that the smallest required details are resolved in the photographic emulsion, but low enough that a useable image can be formed in the emulsion with the number of electrons allowed by the specimen's radiation resistance. As part of a program to optimize recording parameters, a comparative study of various photographic emulsions at exposure levels commonly used for low-dose electron microscopy was made.

911 **Comparison of procedures for quantitative X-ray analysis in thin films.** Sabatini, R.L.; Pande, C.S. (Brookhaven National Laboratory, Upton, NY). pp 129-134 of Microbeam analysis. Newberry, D.E. (ed.). San Francisco, CA; San Francisco Press, Inc. (1979).

X-ray microanalysis of thin films is finding increasing use in the analysis and characterization of materials. In many cases, it supplements the wealth of information already obtained on the same film by such techniques as conventional electron microscopy (TEM), scanning transmission electron microscopy (STEM), and electron diffraction. In recent years, the quantitative aspect of x-ray microanalysis (in which thin-film technique is used not only to identify the elements in a given region of the foil, but also to obtain a quantitative measurement of the various elements present in that region) has acquired great significance, with applications to such important fields as corrosion and phase transformations. It is therefore of some interest to ascertain the accuracy of the procedures by which the quantitative values are obtained from the x-ray spectra. Furthermore, the basic assumptions inherent in this procedure need careful evaluation. Several techniques have been developed for quantitative thin film analysis. For metal films, the three main techniques are (1) analysis using bulk standards, (2) analysis using thin film standards and (3) analysis without standards. We have used all three techniques for the analysis of the same spectra from 304 stainless steel. It is important to ascertain that the composition of the thin film is independent of the film thickness, at least for the range of specimen thicknesses used in the analyses. This assumption is also experimentally checked in this paper.

912 **(N—8321049) Ultraviolet spectrophotometric determination of microgram amounts of sulphite ion.** Okutani, T.; Ito, S.; Utsumi, S. Translated from *Nippon Kagaku Zasshi ;* **88**: No. 12, 1296-1299(1967). 12p. Avail: British Library Lending Div., Boston Spa,;Engl.

The best known method of determining sulphur dioxide is colorimetric determination entailing absorption in sodium tetrachloromercurate solution color development with para-rosaniline and formaldehyde. Determination by absorption in sodium tetrachloromercurate solution and measurement of ultraviolet absorption (228 nm) was described. Mercury (II) nitrate solution was not previously employed as a sulphur dioxide absorbent, since redox reaction occurs with sulphite solutions of high concentration. When determining sulphite by the mercury salt diphenylcarbazone-benzene extraction method, we found that solutions containing a very small concentration of sulphurous acid and excess mercury (II) nitrate ex-

hibited prominent absorption in the ultraviolet region yet remained stable.

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REFER ALSO TO CITATION(S) 30, 60, 88, 157, 215, 215, 216, 784, 800, 942, 1151, 1242, 1429, 1441

913 **(DOE/ER/01797—100) Research in actinide chemistry. Progress report, March 1, 1983-February 28, 1984.** Choppin, G.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1983. Contract AS05-76ER01797. 25p. (ORO—1797-100). NTIS, PC A02/MF A01. Order Number DE84002836.

The complexation and redox behavior of the actinide elements were studied. Methoxybenzoate and benzenepolycarboxylate ligands were studied with lanthanides to measure the degree of polarization of charge induced by the bonded metal cation. Inductive and resonance effects in such intraligand charge transfers were evaluated. Complexation of actinides and lanthanides by ascorbic acid and aminopolycarboxylate ligands are in progress. The latter are providing information on the effect of chelate ring size on complex stability. The binding of actinides to synthetic and natural polyelectrolyte was found to have similar characteristics and confirms a significant role of humus material in actinide environmental chemistry. The kinetics of photochemical reduction of Pu(VI) in TTA solutions was evaluated and a technique for formation and isolation of samples of Pu(V) developed. The reduction of Np(VI) was studied with phenolic and carboxylic compounds. The phenol group is a strong reducing agent as are ionized dicarboxylic acids. For the latter, reduction proceeds via the 1:1 complex. The thermodynamics of synergistic solvent extraction of actinides demonstrated the major role of hydration changes in the actinide species in the organic phase.

914 **(DOE/ER/02542—2) Dynamical studies of molecular systems. Progress report, February 1-September 3, 1983.** Rabitz, H. (Princeton Univ., NJ (USA). Dept. of Chemistry). 1983. Contract AC02-76ER02542. 6p. NTIS, PC A02/MF A01. Order Number DE84002439.

Research was carried out in the general areas of collision dynamics and chemical kinetics: Scaling Relations for Multiplicative Quantum Mechanical Operators; T-matrix Scaling Relations: Necessary and Sufficient Conditions for the Existence of Dynamically Invariant Scaling Coefficients; Sensitivity Methods for Model Analysis and Validation; A Computational Package for Sensitivity Analysis in Chemical Kinetics; Elementary and Derived Sensitivity Analysis in Chemical Kinetics; and Application of Sensitivity Analysis to Combustion Kinetics: A Comprehensive Study of Moist CO Oxidation Kinetics with Elementary Sensitivities.

915 **(DOE/ER/04216—12) Synthesis, chemistry, and catalytic activity of complexes of lanthanide and actinide metals in unusual oxidation states and coordination environments. Final report, February 1, 1977-January 31, 1983.** Evans, W.J. (Chicago Univ., IL (USA). Dept. of Chemistry). 1983. Contract AC02-77ER04216. 13p. (COO—4216-12). NTIS, PC A02/MF A01. Order Number DE84002365.

The above results demonstrate that if the lanthanide metals are in the proper form in terms of oxidation state or ligand environment, they can interact with a variety of neutral unsaturated hydrocarbons, CO, and H_2, they can display unusual organometallic reactivity patterns, and they can homogeneously catalyze reactions involving molecular hydrogen. These are some of the first important steps in the development of truly new lanthanide-centered catalytic reactions. Many of the other results are equally crucial to this goal in providing the necessary basic information on Ln-C, Ln-H, and Ln-O bond-making and bond-breaking processes.

916 **(DOE/ER/04948—3) Energies and bonding in manganese phosphides. Final report, July 1, 1978-December 31, 1982.** Myers, C.E.; Jung, E.D.; Patterson, E.L.; Mevorach, R.A.; Kisacky, G.A. (State Univ. of New York, Albany (USA)). Jun 1983. Contract AC02-78ER04948. 28p. NTIS, PC A03/MF A01. Order Number DE84001807.

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The stabilities of manganese phosphides have been studied by mass-loss Knudsen effusion and by high temperature solid state galvanic cells. Enthalpies of formation and atomization at 298.15 K are (kcal/mole): MnP, ΔH/sub f/° = -27.4 +- 2, ΔH/sub at/° = 173.9 +- 2; Mn_3P, ΔH/sub f/° = 41.3 +- 2, ΔH/sub at/° = 254.5 +- 2; and Mn_2P, ΔH/sub f/° = -42.3 +- 2, ΔH/sub at/° = 322.2 +- 2. Unexpectedly low values for the atomization enthalpies were confirmed. Trends in atomization enthalpies of MnP, FeP, CoP, and NiP were made reasonable by adding the respective valence state preparation energies thereby giving the atomization enthalpies to valence state atoms. Studies of the valence-conduction and core regions of the x-ray photoelectron spectra of SeP, TiP, VP, MnP and FeP show a regular decrease in ionicity in the bonding as well as an increase in metallic character as evidenced by the growth in a d-band.

917 (IAEA-SR—72, pp 348-389) **Mechanism of nitric acid generation on Ag-X Zeolite.** Kanazawa, T.; Kishimoto, T.; Haseba, S.; Mitoh, Y.; Itoh, S.; Nakai, I. (Kobe Steel Ltd. (Japan)). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/26).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

When Ag-X Zeolite is used for the removal of iodine from the off gas streams of nuclear facilities, it is possible that nitric acid is formed on Ag-X Zeolite from co-existing nitrogen dioxide and water vapor. If nitric acid is formed on the surface of Ag-X zeolite, Ag-X zeolite is damaged and is not able to operate for a long time. When Ag-X zeolite is used in NO_2-O_2-H_2O mixture, the nitric acid generation reaction is varied, depending upon the reaction temperature, and concentration of NO_2 and H_2O. At a temperature of more than 40 deg. C, however, only the surface reaction will be progressed on the zeolite surface. The generation of nitric acid solution on the zeolite can be forecasted through the relationship between the concentration of nitric acid solution, equilibrium vapor pressure of H_2O, and equilibrium vapor pressure of HNO_3. Concerning the surface reaction caused on the zeolite, the adsorption water reacts on NO_2, and the resulting HNO_3 is adsorbed firmly by the zeolite, which is thought to interfere with the surface reaction for generation of the HNO_3. When the adsorption bed is long, the time required for adsorbed HNO_3 to saturate is increased in proportion to the bed length.

918 (IAEA-SR—72, pp 397-410) **O_2- and NOsub(x)-removal from the dissolver off-gas by thermal reduction with H_2 or NH_3.** Barnert-Wiemer, H.; Bendick, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). May 1983. NTIS (US Sales Only), PC A99/MF A01. (CONF-8205206—; IAEA-SR—72/19).

From Seminar on the testing and operation of off-gas cleaning systems at nuclear facilities; Karlsruch, F.R. Germany (3 May 1982).

The reference process for the removal of O_2 and NOsub(x) from the dissolver off-gas is the catalytic reduction with H_2. Because of the known disadvantages of catalysts, like reduction in efficiency by poisoning or thermal influence, the alternative method of thermal, flameless reduction with H_2 and NH_3 was tested. The reactions were carried out in a stainless steel and a quartz reactor. Both had a length of 850 mm, an inner diameter of 53 mm, and were heated by resistance heaters on the outside. The main component of the test gases was N_2. Tested throughputs were 600, 800, and 1000 l/h (STP). Different amounts of O_2 (0.5 and 1%), NO (750 and 1500 ppm) and H_2 or NH_3 (-40 to +100% of stoichiometric supply) were added. The reaction temperatures were varied between 450 and 750 deg. C. The goal of these tests was to remove O_2 and NOsub(x) to below 1 ppm behind the reactor and NH_3 (which is formed in the NOsub(x)-H_2-reaction) to below the detection limit of 50 ppm.

919 **(LBL—16561) Thermodynamics of aqueous sodium chloride to 823 K and 1 kbar.** Pitzer, K.S.; Li, Y. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 27p. (CONF-830808—13). NTIS, PC A03/MF A01. Order Number DE84001841.

From International solvent extraction conference; Denver, CO, USA (26 Aug 1983).

It is shown that a very simple semi-empirical equation represents accurately the thermodynamic properties of aqueous sodium chloride from 373 K to 823 K. The equation comprises one Margules term and a Debye-Hueckel term. Just the one Margules parameter is freely adjustable since the Debye-Hueckel parameter is determined by the properties of water. The equation is valid from the saturation composition down to infinite dilution for solvent density above 0.75 g cm^{-3} but at lower density only above a solute mole fraction of about 0.1 on an ionized basis. Both solute and solvent activity coefficients are fitted from the lowest pressure of solution existence up to 1 kbar. Derivation of enthalpy and other related functions is discussed.

920 **(LBL—16625) Thermodynamic properties of very-concentrated electrolyte solutions.** Simonson, J.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 80p. NTIS, PC A05/MF A01. Order Number DE84001865.

Thesis.

Measured solvent vapor pressures and derived solvent activities are reported for the system $LiNO_3$-KNO_3-H_2O at 373, 393, and 436 K. Mean ionic solute activity coefficients, partial molal enthalpies and enthalpies of mixing calculated using this model are tabulated. Measured vapor pressures are reported for the systems $LiNO_3$-NH_4NO_3-H_2O and KNO_3-NH_4NO_3-H_2O at 373 K. A single value for the ion-size parameter of the electrostatic term in the interaction model is shown to be applicable to a number of systems of the general type M/sub i/NO_3-H_2O. Tables of values of the nonelectrostatic interaction parameters for a number of mixed and pure nitrate solutes in water are presented. A generalized multicomponent representation of the nonelectrostatic interaction term of the model is presented and discussed. Measured solvent vapor pressures are presented for the system tetra-n-butylammonium picrate - n-butyl alcohol. Solvent activity in this system is represented, and ionic solute activities calculated, using the electrostatic-nonelectrostatic interaction model both with and without explicit consideration of a proposed ion-pairing equilibrium in this low-dielectric solvent. The ion-pairing equilibrium becomes important at higher dilution.

921 **(LBL—16634) Thermodynamics of condensed ionic systems.** Pitzer, K.S. (Lawrence Berkeley Lab., CA (USA)). Sep 1983. Contract AC03-76SF00098. 33p. (CONF-8309173—1). NTIS, PC A03/MF A01. Order Number DE84001823.

From NATO Advanced Study Institute conference on physics and chemistry of electrons and related ions in condensed matter; Cambridge, UK (4 Sep 1983).

In considering the thermodynamics of condensed ionic systems, primary emphasis will be given to those types which have not been widely investigated, at least until recently. Special attention will be given to systems continuously miscible from the fused salt to dilute solution in a polar solvent. Mixed fused salts will also be considered as well as phase separation and critical phenomena for any type of ionic system. The most important theories are given briefly; the status of more complex or less important theories is described. Semi-empirical equations are discussed where they are the best method of representing the experimental data. 59 references, 7 figures.

922 **(SAND—83-1693C) Chemical modification of chemisorptive and catalytic properties of nickel.** Goodman, D.W. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 26p. (CONF-831174—6). NTIS, PC A03/MF A01. Order Number DE84002046.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

Several reactions representing important categories of catalytic systems have been studied on chemically modified single crystal surfaces: methanation of CO and CO_2, hydrogenolysis of ethane, hydrogenation of ethylene and cyclopropane ring-opening and hydrogenolysis. Poisoning of the above reactions by ordered, submonolayer coverages of sulfur show large nonlinear effects for sulfur coverages versus reactivity attenuation. These data together with related chemisorption results are reviewed with emphasis on the methanation reaction. Related studies have addressed the role of potassium promoters in nickel catalysts for methanation. Potassium decreases the rate of methane formation and increases the rate of higher hydrocarbons relative to the clean nickel surface. Similar results have been reported for supported nickel catalysts suggesting that support effects play a small role in catalytic promotion by potassium.

923 **(SAND—83-1887) Chemistry of shock compression: a bibliography.** Graham, R.A.; Morosin, B.; Dodson, B. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 86p. NTIS, PC A05/MF A01. Order Number DE84002192.

A bibliography and limited evaluation of the literature concerning chemical effects under shock compression is presented. A brief summary of the contents of review articles and listing of conference proceedings is followed by collections of literature on organic substances, inorganic substances, shock-activated sintering, electrochemistry, recovery fixtures and general topics. A complete author index with over 500 entries and a limited subject index are presented. Over 400 references are included in the bibliography.

924 **(UCRL—89436) Pure rotational spectroscopy of SO_2 using fix line far-infrared lasers.** Rinehart, E.A.; Hrubesh, L.W.; Stevens, C.G. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 8p. (CONF-831245—1). NTIS, PC A02/MF A01. Order Number DE84001427.

From 8. international conference on infrared and millimeter waves; Miami Beach, FL, USA (12 Dec 1983).

We have identified approximately 86 near-coincidences between calculated SO_2 pure rotational transitions and known FIR laser lines. Stark modulation and pressure broadening studies on 15 coincidences with the methanol laser lines have been carried out. Differences between measured and calculated frequencies have been observed with higher K quantum number transitions systematically appearing at frequencies lower than calculated. An almost exact match has been observed between the methanol 163.1 μ line and the SO_2 ($25_{14,12}$ reverse arrow $24_{13,11}$) transition, occurring approximately 80 MHz below its calculated frequency. This observation will allow the development of a laser based monitor of trace SO_2 in gaseous mixtures.

925 **(UCRL—89451) Resonance-resonance coupling in dissociative electron attachment.** Hazi, A.U. (Lawrence Livermore National Lab., CA (USA)). 14 Oct 1983. Contract W-7405-ENG-48. 13p. (CONF-8307103—2). NTIS, PC A02/MF A01. Order Number DE84001767.

From International symposium on wavefunctions and mechanisms from electron scattering processes; Castelgandolfo, Italy (24 Jul 1983).

Purpose of this paper is to discuss the effects of resonance-resonance coupling on dissociative electron attachment (DA). It briefly reviews some typical experimental results, and the two alternative theoretical interpretations which have been proposed. It presents the main features of a theory which involves indirect electronic coupling between the resonances and show how it can be applied to the formation of H^- by electron attachment to HBr. In the case of hydrogen halides (HX), DA provides information about the wavefunctions of the two HX^- resonances and the extent of spin-orbit mixing between them.

926 **Theoretical study of the properties of BH_3NH_3 .** Binkley, J.S.; Thorne, L.R. (Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* 79: No. 6, 2932-2940(15 Sep 1983).

Borane monoammoniate (BH_3NH_3) has been studied using several ab initio electronic structure methods and Gaussian basis sets. Equilibrium geometries have been computed at the Hartree—Fock level and, using the electron-correlated Moller—Plesset perturbation method, carried out to third order (MP3) with double-zeta polarized quality basis sets. The computed MP3 geometry is in close agreement with recent microwave data; electron correlation is found to be necessary for a proper description of the B—N distance. Hartree—Fock dipole moments and harmonic vibrational frequencies are presented and discussed. Moller—Plesset perturbation

theory carried out to fourth order with triple-zeta plus polarization basis sets is used to compute a B—N dissociation energy of 34.7 kcal mol^{-1} and a (Hartree—Fock zero-point corrected) rotational barrier of 2.065 kcal mol^{-1}, which is in excellent agreement with the experimental value. Analysis of the dissociation energy as a function of perturbation order indicates that terms involving triple and quadruple substitutions are required in the dissociation energy.

927 **Spectroscopic studies of molecular interactions of oxygen-16 and oxygen-18 in the high-density ϵ-phase.** Swanson, B.I.; Agnew, S.F.; Jones, L.H.; Mills, R.L.; Schiferl, D. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **87**: No. 14, 2463-2465(7 Jul 1983).

Infrared and Raman spectra were obtained for solid $^{16}O_2$ and $^{18}O_2$ as a function of pressure, using diamond-anvil cells. When both isotopes are compressed into the ϵ-phase near 9.9 GPa, a strong infrared band appears in the O-O stretch region, 48 cm^{-1} lower then the Raman-active O-O stretch. As pressure is increased, the infrared absorption shifts to lower frequency, eventually splitting into two bands at 16.0 GPa. Two combination modes, which also shift to lower frequency with increasing pressure, are observed in the 3000-cm^{-1} region of the IR spectra. The ϵ-phase also exhibits a second Raman mode around 130 cm^{-1}, which shifts to higher frequency with pressure. The results indicate that the O-O bond weakens at the expense of forming O_2-O_2 intermolecular interactions in the ϵ-phase. The spectroscopic results show that the structure of the ϵ-phase is centric with, most likely, four molecules per primitive cell.

928 **Comments on the cis, trans, and cyclic dimers of NO.** Ritchie, J.P. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **87**: No. 14, 2466-2468(7 Jul 1983).

Geometry optimizations and force constant c lculations have been performed at various levels of theory for the cis, trans, and cyclic isomers of NO.Even at levels including d orbitals, the calculated geometries and relative energies of the cis and trans isomers show substantial errors, σ-aromaticity may play a role in stablizing the cis isomer. The cyclic structure is verified as a minimum at the SCF level by the calculation of force constants; MINDO/3 and volume calculations lend support to the suggestion that it may be involved in the detonation of NO.

929 **Reaction rates of D_2/T_2 mixtures at 295 K.** McConville, G.T.; Menke, D.A.; Ellefson, R.E. (Monsanto Research Corporation, Mound, Miamisburg, Ohio 45342). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **1**: No. 3, 1441-1446(Jul 1983). Contract AC04-76DP00053.

Reaction rates for the production of DT from D_2+T_2 mixtures are reported as a function of pressure, initial T_2 concentration, and concentration of the impurity of CT_4. The reactions took place in a specially constructed stainless steel container. The reactions are reproducible and can be explained in terms of the ion—molecule chain model of Thompson and Schaeffer. The presence of T_2O as an impurity has no measurable effect at the measured concentration.

930 **Reduction of carbon monoxide by binuclear tantalum hydride complexes.** Belmonte, P.A.; Cloke, F.G.; Schrock, R.R. (Massachusetts Institute of Technology, Cambridge). *Journal of the American Chemical Society;* **105**: No. 9, 2643-2650(4 May 1983).

$[TaCp'Cl_2H]_2$ (Cp' = η^5-C_5Me_4Et) reacts with CO to give yellow, crystalline $Ta_2Cp'_2Cl_4(H)(CHO)$; the hydride bridges the two metals as does the side-on bonded formyl fragment. When PMe=3 is added to $Ta_2Cp'_2Cl_4(H)(CHO)$ the formyl C-O bond is broken to give $Ta_2Cp'_2Cl_4(H)(O)(CHPMe_3)$. The reaction of a mixture of $[TaCP'Cl_2H]_2$ and $[TaCp'Cl_2D]_2$ with CO followed by PMe_3 to give only a mixtue of $Ta_2Cp'_2Cl_4(H)(O)(CHPMe_3)$ and $Ta_2Cp'_2Cl_4(D)(O)(CDPMe_3)$ suggests that the dimer does not fragment when it reacts with CO. This was confirmed by a crossover experiment involving $[TaCp'Cl_2H]_2$ and [TaCp/sup s/$Cl_2H]_2$ (Cp/sup s/ = η^5-1,3-$C_5H_3(SiMe_3)_2$). $[TaCp'Cl_2H_2$ forms a green, diamagnetic pyridine adduct that contains two inequivalent hydride ligands. $[TaCp'Cl_2H]_2$ forms an unstable, purple CO adduct that shows a terminally bound CO band (v/sub CO/ = 1939 cm^{-1}) and two different hydride bands (v/sub MH/ = 1560 and 1599 cm^{-1}) in the IR spectrum of a thin film at -78°C, and a singlet ascribed to the carbonyl carbon atom at 238 ppm in the ^{13}C NMR spectrum. $[TaCp'Cl_2H]_2(CO)$ decomposes rapidly in solution or in the solid state at -30°C to give $Ta_2Cp'_2Cl_4(H)(CHO)$ quantitatively. Methane is formed in ~70% yield when $Ta_2Cp'_2Cl_4(H)(CHO)$ is treated with $AlCl_3$ under molecular hydrogen. Methanol is formed in high yield when $Ta_2Cp'_2Cl_4(H)(CHO)$ is hydrolyzed with aqueous HCl.

931 **UO_2-Zircaloy chemical interaction.** Olander, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Nuclear Engineering). *Journal of Nuclear Materials;* **115**: No. 2/3, 271-285(Apr 1983).

Existing experimental data on the interaction of uranium dioxide and Zircaloy are analyzed with a model that accounts for the formation and growth of three corrosion layers between the oxide and the metal. The kinetics of the process are governed by diffusion of oxygen and uranium in the five-zone system with chemical equilibrium at four interfaces. Three of the zones consist of two elements and are treated by conventional scaling theory. Transport of all three elements (Zr, U, and O) occurs in the remaining two zones, one of which consists of two coexisting phases. Modeling of the system results in product layer growth rates which are in good agreement with the experimental results at 1500°C, which is the only temperature that both kinetic and thermodynamic information is available for application of the theoretical model.

932 **Thermodynamics of sodium chloride solutions in steam.** Pitzer, K.S. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **87**: No. 7, 1120-1125(31 Mar 1983). Contract AC03-76SF00098.

Gas-phase data from mass spectrometry are used to calculate the Gibbs energy of hydration of Na^+ and Cl^- ions in steam. A similar hydration model for the ion pair NaCl is fitted to the experimental measurements of the solubility of NaCl in steam. The ionization constant calculated from these sources fits the directly measured values at 1073K and densities above 0.3g cm^{-3}. At lower temperatures reasonable curves interpolate between the calculated values for low density and the direct measurements at higher density. Other thermodynamic properties are calculated for Na^+, Cl^-, and NaCl in steam. The partial molal heat capacity of the ions is very large in the range 700-1000K; this arises from the enthalpy of dissociation of water from the hydrated ions. The Born equation is compared with these results. A practical application to steam turbine technology is also considered.

933 **Molecular orbital study of proton transfer in $(H_3NHOH_2)^+$.** Scheiner, S. (Southern Illinois Univ., Carbondale); Harding, L.B. *Journal of Physical Chemistry;* **87**: No. 7, 1145-1153(31 Mar 1983). Contract W-31-109-ENG-38.

Ab initio molecular orbital methods are used to study transfer of the central proton in the asymmetric $(H_3NHOH_2)^+$ system. Calculations are performed at the Hartree-Fock level with basis sets of split-valence (4-31G) and double-zeta plus polarization function (DZP) quality. The effects of electron correlation upon the transfer potentials are computed via the generalized valence bond (GVB) and polarization configuration interaction (POL-CI) techniques. The barrier to proton transfer between NH_3 and OH_2 is observed to heighten as the distance between the latter two molecules is increased. At the equilibrium R(NO) hydrogen-bond length, the transfer potential contains a single minimum, $(H_3NH...OH_2)^+$, in which the central proton is more closely associated with NH_3. In both the rapid and adiabatic models of proton transfer, there is no energy barrier to decay of $(H_3N...HOH_2)^+$ to the equilibrium $(H_3NH...OH_2)^+$ structure. While all the calculations agree on the above points, there are some notable quantitative discrepancies between the various methods. Enlargement of the basis set at the Hartree-Fock level results in higher transfer barriers while subsequent inclusion of electron correlation (POL-CI) leads to barrier reductions. The GVB procedure, with its partial treatment of correlation, produces changes in the potentials opposite to those observed for the more complete POL-CI treatment.

934 **Thermodynamic properties of aqueous solutions of the alkali metal chlorides to 250°C.** Holmes, H.F.; Mesmer, R.E. (Oak Ridge National Laboratory, TN). *Journal of Physical Chemistry;* **87**: No. 7, 1242-1255(31 Mar 1983). Contract W-7405-ENG-26.

Osmotic coefficients of LiCl(aq), KCl(aq), and CsCl(aq) have been determined, at 225 and 250°C, by isopiestic comparison with NaCl(aq). Equilibrium molalities ranged up to 8 mol kg^{-1}. Isothermal osmotic data can be precisely described by the ion interaction model of Pitzer. The osmotic, and activity, coefficients continue to decrease with increasing temperature with LiCl(aq) retaining a measure of individuality when compared to the other alkali metal chlorides. Our present results have been compared and combined with previously reported thermodynamic data (isopiestic and vapor pressure measurements, electrochemical cell potentials, freezing temperature determinations, enthalpies of solution and dilution, and heat capacities) within the framework of the ion interaction model. The resulting set of equations provides a thermodynamic description, essentially within the accuracy of the reported experimental results, of LiCl(aq), KCl(aq), and CsCl(aq) as a function of temperature (from 0 to 250 °C) and molality (up to about 6 mol kg^{-1}). The ion interaction parameter β/sup (0)/ was in the order LiCl > NaCl > KCl > CsCl at all temperatures. The same trend was observed for the excess thermodynamic properties phi, γ, and /sup phi/L. Contributions of the short-range interactions to the activity coefficient (ln γ - f/sup γ/) are shown to be linearly related to the reciprocal radius of the cation. Excess free energy data for the alkali metal chlorides to 250°C can be modeled surprisingly well with a single parameter--the hard-core diameter--using the theoretical form of the ion interaction model.

935 **Raman scattering studies of ionic → moleclar transitions in $AlCl_3$ near the melting point.** Aliotta, F. (Istituto di Fisica dell'Universita di Messina, Italy); Maisano, G.; Migliardo, P.; Vasi, C.; Wanderlingh, F.; Triolo, R.; Smith, G.P. *Physics And Chemistry of Liquids;* **12**: No. 3, 225-235(1983).

Raman spectroscopic studies of solid $AlCl_3$ as a function of the temperature were performed up to the melting point (T = 193.3°C). Measurements were also performed on molten $AlCl_3$, known to be a molecular liquid. In particular, the evolution of the dynamical properties of the system was studied near and through the solid-liquid transition. The temperature evolution of a phonon mode centered at 196 cm^{-1} seems to herald the melting transition, and we identify this phonon as the soft mode theoretically foreseen by March and Tosi. Furthermore, our analysis of the Raman data in the melt provided an interpretation of the quasi-elastic central component (Rayleigh wing); its width gave an indication about the mean life time of intermolecular bonds. Finally, we detected a phonon-like contribution that gives an effective Raman density of states.

936 **Adsorption and catalysis on rare earth surfaces. Chapter 43.** Netzer, F.P.; Bertel, E. (Innsbruck Univ. (Austria). Inst. fuer Physikalische Chemie). pp 217-320 of Handbook on the physics and chemistry of rare earths. Volume 5. Gschneidner, K.A. Jr. (Ames Lab., IA (USA)); Eyring, L. (Arizona State Univ., Tempe (USA). Dept. of Chemistry) (eds.). Amsterdam, Netherlands; North-Holland (1982).

The authors review surface chemistry on rare earth related materials, that is, published information on the interaction of gases on and with rare earth surfaces is evaluated. The present treatment is therefore confined to phenomena occurring on the gas-solid interface. Conventional studies of catalytic processes on rare earth surfaces have been known for quite a number of years, but it is only recently that studies on well-defined rare earth surfaces involving modern methods of surface science have been initiated. This field, however, is rapidly expanding. It therefore seems timely to examine surface reactions on rare earth materials in the light of the present knowledge of surface science in order to establish the present state of the art and to provide a basis for future research in this area.

937 **Amorphous silica solubilities--III. Activity coefficient relations and predictions of solubility behavior in salt solutions, 0-350°C.** Marshal, W.L. (Oak Ridge National Laboratory, TN). *Geochimica et Cosmochimica Acta;* **44**: No. 7, 925-931(1980). Contract W-7405-ENG-26.

Activity coefficients of amorphous silica in added salt solutions, obtained from solubility measurements, were calculated on the basis of concentration (molarity) and compositon (molality). The logarithm of the activity coefficients based on concentration when plotted against molarity of added salt, as previous observations would dictate, yielded straight line relations even to 6 M. The use of composition units produced instead curves at the highest molalities and caused divergences in behavior from the single straight lines for 1-1 salts of a common cation. Introduction of the activity of water also caused divergences in behavior. Thus, it might appear that amorphous silica is fully hydrated at 25°C as a solid in equilibrium with solution. Lack of densities of aqueous sodium nitrate necessitated using units of molality in interpretations at high temperatures. Nevertheless, approximately straight line behavior of log activity coefficient vs m was still observed to reasonably high molalities, and allowed a simple equation to describe activity coefficient behavior as a function of both molality of sodium nitrate and temperature. The simplicity of the relation, with some assumptions, might be used to predict solubility of amorphous silica at high temperatures in other added aqueous salt solutions.

938 **Pressure dependence of Raman scattering in ferroelectrics and ferroelastics.** Peercy, P.S. (Sandia Lab., Albuquerque, NM). pp 279-298 of High-pressure and low temperature physics. Chu, C.W.; Woollam, J.A. (eds.). New York, NY; Plenum Publishing Corporation (1978).

Inelastic light scattering at high pressure from soft mode systems is briefly reviewed. Examples of the different types of soft-mode systems in which the pressure dependence of Raman and Brillouin scattering have been investigated are summarized. Special emphasis is given to three important systems: the coupled-proton-optic mode in hydrogen bonded ferroelectrics of the KDP class, the tricritical behavior in the ferroelectric SbSI, and optic-acoustic interactions in the ferroelastic rare-earth pentaphosphates.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 30, 34, 73, 78, 150, 612, 923, 964, 1283

939 **(IFP—30-664) Epoxidation of olefines by hydroperoxides catalyzed by molybdenum and vanadium complexes. Synthesis, characterization and reactivity of peroxo and alkylperoxo intermediates.** Chaumette, P. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 1983. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84750125.

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New oxoperoxo molybdenum (VI) complexes of general formula $MoO(O_2)\ X_2L_2$ III (L = DMF, HMPT) and MoO (O_2) Cl (O-N) L IV (O-N = pyridine 2-carboxylate (Pic), 8 hydroxyquinolinate (Quin) were prepared by reaction of Ph_3COOH or H_2O_2 with the corresponding cis-dioxo complex. Isotopic ^{18}O labellings shows that both the peroxo oxygen atoms derive from hydroperoxide. An X-ray crystallographic study of the complex MoO (O_2) Cl(Pic) (HMPT) reveals a pentagonal bipyramidal structure with quite a short O-O distance (1.41 A). The III complexe are more reactive than $MoO(O_2)_2$ HMPT for epoxydation of defins, and oxidative degradation products are observed. However these complexes react according to the same cyclic peroxymetallization mechanism. The lack of reactivity of the IV complexes shows that a detachable equatorial coordination position adjacent to the peroxo group is necessary for the transfer of oxygen to take place. A study of the catalytic reaction in the presence of oxygen 18-labelled catalyst shows that the active species is alkylperoxidic when the oxidising agent is tBuOOH, whereas a peroxo species is present when Ph_3COOH is used. The mechanism of olefin epoxydation by hydroperoxides, catalysed by metals, is discussed. The synthesis of vanadium (V) alkylperoxide complexes for the first time from tertiobutyl hydroperoxide illustrates the alkylperoxidic nature of the active species in the catalytic act.

940 **(ORNL/TM—8956) Chemical characterization and toxicologic evaluation of airborne mixtures. Chemical characterization of Army colored smokes: inventory smoke mixes (red, violet, yellow, and green). Final report, 1980-1981.** Rubin, I.B.; Buchanan, M.V. (Oak Ridge National Lab., TN (USA)). Jun 1983. Contract W-7405-ENG-26. 60p. NTIS, PC A04/MF A01. Order Number DE84002257.

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Red, violet, yellow, and green inventory smoke mixes were fractionated by vacuum sublimation, differential solubility and liquid chromatography. Two unique components, benzanthrone and dibenzochrysenedione, were purified by the same methods. Major components of the smoke mixes were isolated and identified by comparison to the pure dyes using a variety of instrumental techniques. A number of contaminants at very minor levels were identified by gas chromatography/mass spectroscopy. All of the smoke mixes contained relatively large quantities (10 to 25 percent) of chloroform insoluble or non-volatile undifferentiated carbonaceous material.

941 **Deuterium isotope effects for hydrocarbon reactions catalyzed over platinum single crystal surfaces.** Davis, S.M.; Gillespie, W.D.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **83**: No. 1, 131-140(Sep 1983). Contract W-7405-ENG-48.

The initial rates of isobutane, neopentane, cyclohexane, n-hexane, and n-heptane skeletal rearrangement reactions catalyzed in the presence of deuterium gas over the flat(111), stepped(13,1,1), and kinked(10,8,7) platinum single crystal surfaces were measured at atmospheric pressures and 520 to 640 K. Inverse isotope effects [(R/sub D//R/sub H/) = 1.3 to 3.3] were detected for a variety of hydrogenolysis, isomerization, and C_6 cyclization reactions. The inverse isotope effects that appear to arise from a combination of kinetic and thermodynamic isotope effects displayed magnitudes that were not dependent on the platinum surface structure. 6 figures, 3 tables.

942 **Characterization of Pd-on-alumina and Pd-Si glasses by isomerization and hydrogenation of (+)-apopinene.** Smith, G.V.; Zahraa, O.; Molnar, A.; Khan, M.M.; Rihter, B.; Brower, W.E. (Southern Illinois Univ., Carbondale). *Journal of Catalysis;* **83**: No. 1, 238-241(Sep 1983). Contract AC02-81ER10897.

The hydrogenation and isomerization of (+)-apopinene were performed using deuterium gas. In a typical experiment, a 500-μl sample was injected onto a palladium catalyst which had been pretreated with deuterium for several h. Shaking the reaction vessel at 2200 rpm resulted in hydrogenation. After the desired % hydrogenation was accomplished, the reaction mixture was analyzed by gas chromatography (GC), resulting in good agreement between the amount of deuterium used and the amount of apopinene produced. The GC column was also used to separate the remaining apopinene from the reaction mixture for optical analysis using a polarimeter. The preparation of the palladium on alumina catalysts and the palladium-silicon splats are described. A series of these experiments was using different wt % of catalysts. Results indicate that (+)-apopinene has potential for the characterization of catalytic surfaces. Surface features have been revealed that are not readily available via surface techniques or have not been characterized by chemical means. The data seem to favor a glassy surface structure that is three-dimensionally random (hilly or rolling). 1 figure, 1 table.

943 **Lithium tungsten dioxide promoted Claisen-Tishchenko condensation of aromatic and aliphatic aldehydes.** Villacorta, G.M.; Filippo, J.S. Jr. (Rutgers University, New Brunswick, NJ). *Journal of Organic Chemistry;* **48**: No. 8, 1151-1154(22 Apr 1983). Contract AS05-80ER10662.

Lithium tungsten dioxide, $LiWO_2$, has been shown to be a useful catalyst for effecting the Claisen-Tishchenko condensation of aldehydes under heterogeneous conditions.

944 **A theoretical model of metal surface reactions.** Shustorovich, E. (Eastman Kodak Co., Rochester, NY); Baetzold, R.C.; Muetterties, E.L. *Journal of Physical Chemistry;* **87**: No. 7, 1100-1113(31 Mar 1983). Contract AC03-76SF00098.

Metal surface reactions are modeled with a novel theoretical construct in which periodic trends can be scrutinized. The theoretical model is succinctly presented and a conspectus of periodic trends, based on the model, is explored. Periodic trends are discussed in the contexts of chemisorption bond energies, electron transfer between metal surface and adsorbate, stereochemical features of chemisorption states for closed-shell diatomic and linear X-CN or X-NC molecules, and hydrocarbon reactions. Hydrocarbon C-H bond-breaking processes are analyzed in terms of d-level occupancy, electron transfer, and stereochemistry of intermediates. Conceptually and computationally, the metal surface is characterized as a good electron donor: antibonding molecular orbitals of the adsorbate species appear to be significant contributors to the chemisorption bond and also play a decisive role in bond-breaking processes. No aspect of the model projections is inconsistent with the experimental data although the electronic characterization of some chemisorption states are counter to commonly held perceptions.

945 **Hydroxide complex of the magnesium octaethylporphyrin cation: Spectrum and formation constant in alcohol-water solvents.** Smalley, J.F.; Feldberg, S.W. (Brookhaven National Lab, Upton, NY). *Journal of Physical Chemistry;* **87**: No. 7, 1230-1235(31 Mar 1983). Contract AC02-76CH00016.

The formation of the complex between photogenerated magnesium octaethylporphyrin cation and hydroxide has been studied in mixed alcohol/water solvents. This complex has been postulated as a participant in the transport of hydroxide and/or hydrogen ion across bilayer lipid membranes. The absorption spectrum of the complex (λ/sub max/=665nm) is red shifted from that of the cation (λ/sub max/=680nm) in both methanol/water (M/W) and ethanol/water (E/W). The difference in the two constants is too great to be explained entirely by the Born equation (with correction for ion screening) in which the dielectric constant of the solvent system is the pertinent variable. Differential solvation effects appear to be involved. The rate constants, k_2, for the reaction of the cation with the p-dinitrobenzene anion, p-DNB^- (p-DNB is the electron acceptor for the photogeneration of the maagnesium octaethylporphyrin cation), and k_4, for the reaction of the complex with p-DNB^-, are 1.1 X 10^9 and 2.1 X 10^9 $M^{-1}s^{-1}$ in M/W and 1.3 X 10^9 and 1.2 X 10^9 $M^{-1}s^{-1}$ in E/W. Although the rate constants are within an order of magnitude of being diffusion controlled, the fact that $k_4 \leqq k_2$ is indicative of some degree of activation control.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 83

946 **(LBL—13632) First generation of bubbles at gas-evolving electrodes.** Cettou, P.; Tobias, C.W. (Lawrence Berkeley Lab., CA (USA)). 5 Dec 1981. Contract AC03-76SF00098. 72p. NTIS, PC A04/MF A01. Order Number DE84001499.

We have observed the growth of the first generation of bubbles at gas-evolving electrodes by high speed motion picture and measured the increase of the electrical resistance during this period. The resistance of the bubble layer constitutes a significant part of the overall cell resistance. To reduce this resistance, either the electrode coverage or the bubble layer thickness can be lowered. Our studies show that strong coalescence, which occurs most readily in sulfuric acid, promotes both of these desired effects.

947 **(LBL—16176) Mass transfer at gas-evolving surfaces in electrolysis.** Dees, D.W.; Tobias, C.W. (Lawrence Berkeley Lab., CA (USA)). Sep 1983. Contract AC03-76SF00098. 307p. NTIS, PC A14/MF A01. Order Number DE84002567.

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A novel micro-mosaic electrode was developed to resolve time-dependent, mass-transfer distribution in the close vicinity of bubble phenomena. The electrode, prepared on a silicon wafer using integrated circuit manufacturing technology, consists of a 10 by 10 matrix of coplanar, electrically isolated, square platinum segments on 100 micron centers, surrounded by a relatively large buffer segment. A computer-actuated data acquisition and control system was assembled and the software developed to monitor the current to each of the segments and control the potential of selected segments. The utility of the electrode to examine interfacial mass transport phenomena which have characteristic lengths as small as 100 microns has been clearly demonstrated. The effect of a single hydrogen bubble disengagement and of the coalescence of two bubbles, on the limiting current of the reduction of ferric to ferrous ion was measured using the micro-mosaic electrode in a horizontal: facing-up orientation. In the absence of gas evolution, large regular fluctuations in the limiting current to the segments with a period of 29 sec were observed. This periodic behavior is attributed to free convection: a cellular fluid motion moving across the electrode with a velocity of 40 microns/second. It was found that the mass-transfer enhancement due to bubble disengagement is small when compared to that due to coalescence. Increases in the mass-transfer rate of more than an order of magnitude over the free convection limiting current were observed for the coalescence phenomena. Two theoretical models were developed to account for the observed effect of a bubble disengagement on the mass transfer-rate to the surface.

948 **Absorption spectra of Pu(VI), -(V) and -(IV) produced electrochemically in carbonate-bicarbonate media.** Wester, D.W.; Sullivan, J.C. (Argonne National Lab., IL (USA)). *Radiochemical and Radioanalytical Letters;* **57**: No. 1, 35-42(31 May 1983).

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Absorption spectra in carbonate and bicarbonate media have been measured for various oxidation states of plutonium. The oxidation state of plutonium was adjusted electrochemically (Pu(VI)-V), Esub(f)=+0.11 V vs. SCE) to avoid contamination by redox reagents. In carbonate medium the spectra of Pu(VI) and Pu(V) showed marked differences from the spectra of the same oxidation state in acidic solutions. In bicarbonate the spectra of Pu(VI) and Pu(IV) also differed from the corresponding spectra in acidic media. Reduction to Pu(III) resulted in a precipitate in both carbonate and bicarbonate media.

4005 Photochemistry

949 **(DOE/ER/70217—T1) Intermolecular energy-transfer processes. Final technical report, May 1, 1979-March 31, 1983.** Lee, E.K.C. (California Univ., Irvine (USA). Dept. of Chemistry). 10 Oct 1983. Contract AT03-76ER70217. 29p. NTIS, PC A03/MF A01. Order Number DE84000334.

Equipment used for the fluorescence excitation and emission spectroscopy are described. The following were studied: singlet electronic energy transfer, photophysics of single vibrational levels (H_2CO), photophysics of single rotational levels (H_2CO and SO_2), rotation-vibration interaction by Coriolis perturbation, and matrix isolation photochemistry and spectroscopy (SO_2, H_2CO, $H_2C_2O_2$). 13 figures.

950 **Energetics of photosynthetic glow peaks.** DeValt, D. (Univ. of Illinois at Urbana-Champaign); Govindjee; Arnold, W. *Proceedings of the National Academy of Sciences of the United States of America;* **80**: No. 5, 983-987(Feb 1983).

By postulating temperature-dependent equilibria between two or more electron carriers acting as traps for electrons or holes, it is possible to modify the Randall-Wilkins theory of thermoluminescence so as to explain the abnormally large apparent activation energies and apparent frequency factors observed in photosynthetic glow curves when fitted by unmodified Randall-Wilkins theory. The equilibria serve to inhibit the formation of the light-emitting excited state by withholding the needed precursor state. When the inhibition is released at higher temperature by shift of equilibrium with temperature, the rise of the glow peak can be much faster than would result from Arrhenius behavior based on the true activation energy and so appears to correspond to a higher activation energy accompanied by a larger frequency factor. From another viewpoint, the enthalpy changes, ΔH, of the equilibria tend to add to the activation energy. Similarly the entropy changes, ΔS, of the equilibria tend to add to the entropy of activation, giving the large apparent frequency factors. The positive values of ΔS needed would correspond to entropy decreases in the forward early electron transport. A comparison of the glow peaks obtained by different workers is also presented.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 1059

951 **(JAERI-M—82-059) Preparation of metal ion exchange resin by radiation-induced graft copolymerization.** Nakase, Y.; Akasaka, N. (Japan Atomic Energy Research Inst., Tokyo). Jun 1982. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703703.

Radiation-induced graft copolymerization of 2-acrylamide-2-methyl propane sulfonic acid (AMPS) onto polyvinylchloride (PVC) and polyvinylidene chloride resin (PVD) was investigated in the water-acetone system and their adsorptive activities to metal ion were also examined. In the case of PVC, the degree of grafting increased with the increase of acetone content, but the adsorptive activity to metal ions (mainly lithic ion) became maximum in the system with water/acetone of 2/3. Grafted PVC prepared at about 35°C and at a higher concentration of AMPS showed higher adsorption activity than the other cases. In the case of PVD, a similar result was obtained with the case of PVC except the temperature dependence and effect of swelling agent. Polymerizations at temperatures of 35 and 50°C showed no effect on the degree of grafting, and the usage of a swelling agent was quite effective to the adsorptive activity. Glass transition temperature of the grafted copolymer was the same as that of original polymer, and their thermal stability was confirmed up to the temperature at which homopolymer of AMPS decomposed, about 180°C.

952 **(OEFZS—4198) Conservation experiments applying radiation-curable impregnating agents to intact and artificially decayed wood samples.** Schaudy, R.; Slais, E. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Feb 1983. 12p. (In German). (CH—314/83). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703705.

Conservation experiments have been performed applying 10 selected impregnating agents to intact and chemically as well as biologically decayed wood samples. The quality of the radiation-curable impregnating agents could be valued by determination of the monomer uptake, the alteration of dimensions and volume and the deformation of the samples. The results are to be discussed.

953 **(OEFZS—4220) Radiation chemical production of resin-bonded paper laminates.** Wendrinsky, J.; Proksch, E.; Grienauer, W. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). May 1983. 30p. (In German). (CH—318/83). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703706.

The possibility of producing resin-impregnated paper and web laminates by the energy saving and environment preserving technology of electron beam curing has been examined. The experimental investigations showed that acrylic-modified melamine resins diluted by about 20 w/o of low-volatile acrylic monomers proved to be the optimum resin component for this process. Papers and webs impregnated by these resins can be cured at a maximum dose of about 65 kGy yielding high quality laminates without any emission of toxic gases or vapours. The process itself exhibits a rather high adaptability. By the variation of both the initial material and the process parameters products of rather different properties can be manufactured. A technical realization of this process should be possible without any difficulties and at competitive costs.

954 **Trigonal-^{13}C hyperfine coupling in CF_3CCl_2 .** Walther, B.W.; Williams, F. (Department of Chemistry, University of Tennessee, Knoxville, Tennessee 37996-1600). *Journal of Chemical Physics;* **79**: No. 6, 3167-3169(15 Sep 1983).

An intense isotropic ESR spectrum of CF_3CCl_2 is generated by annealing γ-irradiated samples of CF_2CCl_2 above 145 K, the sudden spectral change being irreversible and probably corresponding to the loss of a chloride ion from the $CF_3CCl_2^-$ radical anion. Satellite lines detected at high gain are assigned to $CF_3{}^{13}CCl_2$ with a ^{13}C hyperfine coupling of 67.3 G, showing that th radical possesses a more planar configuration than that of the CCl_3 radical (^{13}C hfc≃116 G). This result strongly supports a previous argument that increasing the electronegativity of the α substituent is much less important than the effect of π-conjugative destabilization in promoting the pyramidality of alkyl radicals. (AIP)

955 **Thermal-energy storage in crosslinked pellets of high-density polyethylene for home heating and cooling via off-peak electric power utilization.** Salyer, I.O.; Davison, J.E. (Univ. of Dayton Research Inst., OH). *Journal of Applied Polymer Science;* **28**: No. 9, 2903-2924(Sep 1983).

Electron beam cross-linking of high-density polyethylene (HDPE) was studied to obtain pellets for phase-change thermal-energy storage that retain their original shape and form through repeated melt/freeze cycles, and thus serve as their own container. Electron-beam voltage, amperage, atmosphere, pellet-bed depth, traverse rate, and total dose were varied to establish cost/effective conditions for adequate thermal form stability combined with highest retention of heat of fusion. The results of electron beam crosslinking are compared with chemical crosslinking in cost and effectiveness. Utility of the electron-beam crosslinked HDPE pellets in a low-cost, efficient pellet-bed heat exchanger was demonstrated. Potential applications discussed include thermal storage for home heating and cooling, industrial processing, and off-peak electric utilization for load leveling. 15 figures, 5 tables.

956 **Laser and pulse radiolytically induced colloidal gold formation in water and in water-in-oil microemulsions.** Kurihara, K. (Clarkson Coll. of Tech., Potsdam, NY); Kizling, J.; Stenius, P.; Fendler, J.H. *Journal of the American Chemical Society;* **105**: No. 9, 2574-2579(4 May 1983).

Reduction of $HAuCl_4$ has been investigated pulse radiolytically in water and in water-in-oil microemulsions. Rate constants have been determined for Au^{2+} + e/sub aq/$^-$ → Au^{2+}, $2Au^{2+}$ → Au^{3+} + Au^+, and Au^+ + R^-. → Au^0 + R (where R^-. is an unidentified radical). On the longer time scale formation of colloidal gold, nAu^0 → $(Au^0)n$, has been observed. Rate of colloidal gold formation has also been studied in the bombardment of $HAuCl_4$ solutions by 353-nm 60-mJ 3-5-ns laser pulses. Hydrodynamic diameters and polydispersities of empty and colloidal-gold-containing microemulsions have been determined by electron micrography. There are a number of advantages of forming colloidal particles in microemulsions. Under identical conditions a greater amount of colloidal particles is formed than that in water. Colloidal gold particles formed in microemulsions are smaller and more uniform than those obtained in homogeneous solutions.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 291, 931, 948, 1286, 1304

957 **(BNL—33786) Use of miniature C-14 counters in dating and authentication in the museum.** Harbottle, G.; Sayre, E.V.; Stoenner, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 29p. (CONF-8309174—1). NTIS, PC A03/MF A01. Order Number DE84001651.

From 5. international seminar applications of science in examination of works of art; Boston, MA, USA (7 Sep 1983).

Curators often do not understand the basis for the C-14 method of age determination and its limitations. Purpose of this paper is to describe the underlying principles, and how these must influence the interpretation of the radiocarbon measurement of a museum specimen in terms of age. Several techniques for that measurement are described briefly, focussing on the miniature proportional counters that were developed for the Smithsonian Institution, and three museum problems are described which were attacked, and some interesting further research on museum objects that has been proposed. Finally some projections on the future applications of the different methods are made, in the context of museum work.

958 **(EUR—7700) Contributions to radiochemical and nuclear materials research.** Matzke, H. (Commission of the European Communities, Luxembourg). 1982. 189p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE83703700.

Series of talks given during a seminar of the European Institute for Transuranium Elements in april 1981 in honor of R. LINDNER on the occasion of his 60th birthday. The topics include general aspects of research practice and science prognosis, retrospective essays about the discovery of nuclear fission by O. HAHN as well as surveys of actual research activities concerning a radiochemistry and the use of radioactivity in material science.

959 **I.R. absorption spectra of hexavalent uranium chloride fluorides.** Maier, W.B. II; Beattie, W.H.; Holland, R.F. (Los Alamos National Lab., NM (USA)). *Journal of the Chemical Society, Chemical Communications;* No. 10, 598-599(15 May 1983).

The i.r. absorption spectrum of UFsub(6-n)Clsub(n), 0 <= n <= 6, dissolved in liquid xenon, is given and strong bands of each species are identified.

960 **Effect of structural alterations on the uptake and clearance of primary aliphatic amines in rat lung.** Washburn, L.C.; Sun, T.T.; Byrd, B.L. (Oak Ridge Associated Universities, Inc., TN (USA). Medical and Health Science Div.); Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). *Journal of Labelled Compounds and Radiopharmaceuticals;* **19**: No. 11-12, 1282-1283(Nov-Dec 1982). (CONF-8208101—).

From 4. international symposium on radiopharmaceutical chemistry; Juelich, F.R. Germany (23 Aug 1982).

^{14}C-labelled ₁methyloctylamine was synthesised to study the effect of chain branching on the lung uptake and clearance of diphotic amines in rats. Results were compared with those for the uptake and clearance of 2-methyloctylamine, octylamine and 2,2-dimethyloctylamine.

961 **Reactor production of osmium-191: factors important for clinical applicat¹on of the ^{191}Os-sup(191m)Ir ultra-short-lived radionuclide generator.** Butler, T.A.; Guyer, C.E.; Knapp, F.F. Jr. (Oak Ridge National Laboratory, TN (USA)). pp 617-621 of Nuclear medicine and biology. Proceedings Vol. 1. Raynaud, C. (ed.). Paris, France; Pergamon (1982). (CONF-820804—).

From 3. world congress of nuclear medicine and biology; Paris, France (29 Aug 1982).

It has been shown that ^{191}Os for use in ^{191}Os-sup(191m)Ir radionuclide generators can be produced in multicurie amounts by neutron irradiation of enriched ^{190}Os in the High Flux Isotope Reactor (HFIR). A 3-4 day irradiation period is indicated to be a suitable choice for routine production of ^{191}Os in order to avoid problems associated with increasing levels of induced radionuclide impurities (^{190}Os, ^{192}Ir, and ^{194}Ir) and decreasing yields of ^{191}Os due to neutron capture (burnup) of this radionuclide. Further, it has been shown that the most undesirable radiocontaminant, ^{192}Ir, can be removed by generator column washing with HCP prior to the clinical use. By contrast, irradiation of natural osmium as a source of ^{191}Os was shown to be undesirable because of the introduction of ^{188}Os (T1/2, 94d) and greatly increased amounts of ^{190}Os, ^{192}Ir, and ^{194}Ir radionuclide impurities.

962 **Compiex oxide systems of the actinides.** Morss, L.R. (Argonne National Lab., IL). pp 381-407 of Actinides in perspective. Edelstein, N.M. (ed.). New York, NY; Pergamon Press (1982). Contract W-31-109-ENG-38.

This article reviews recent research on the structural, thermodynamic, magnetic, and spectroscopic properties of ternary and

other complex oxides containing actinide ions. Since complex oxides often exhibit unusual coordination sites and oxidation states for transition elements, the unique properties of complex oxides are emphasized. For completeness, a brief summary of properties of the binary oxides is also given. Properties of isostructural and isoelectronic series of oxides are compared in terms of structure-stability relationships, magnetochemistry, spectroscopy (photoelectron, Moessbauer, vibrational, and electronic), and synthetic procedures. 110 references, 8 tables.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

963 **(DOE/ER/10964—T4) PDF: a computer program for calculation of turbulent combustion utilizing a probability density function (PDF) approach.** Wormeck, J.J. (Dynamics Technology, Inc., Torrance, CA (USA)). Sep 1983. Contract AC03-81ER10964. 119p. NTIS, PC A06/MF A01. Order Number DE84002525.

This report contains a detailed description and user's guide for a collection of FORTRAN-77 subroutine subprograms which enable the extension of any existing hydrodynamic computer code to the calculation of multi-dimensional, laminar or turbulent flows with chemically complex equilibrium stationary states. The version of PDF described is limited to adiabatic, homogeneous, ideal gas-phase chemical equilibrium. An example calculation is given for a parabolic flow for mixing and combustion of initially unmixed methane and air in a simple shear flow.

964 **(DOE/PC/40805—6) Fundamentals of nitric oxide formation in fossil-fuel combustion. Sixth quarterly progress report, 29 December 1982-28 March 1983.** Houser, T.; McCarville, M.E. (Western Michigan Univ., Kalamazoo (USA). Dept. of Chemistry). Aug 1983. Contract FG22-81PC40805. 8p. NTIS, PC A02/MF A01. Order Number DE84001519.

The study of the oxidation of HCN using an atmospheric pressure flow system with a plug flow reactor was continued. Attempts to find conditions at which NO formation from the oxidation of HCN-fuel additive mixtures was in its initial stages were again unsuccessful. Nine samples of white solid product formed from HCN oxidation at flameless conditions (negligible NO yields) were collected and examined. From infrared and elemental analyses and physical characteristics it appeared that the product was ammonium cyanate at low extents of reaction and when CO was the additive. However, when hydrogen was the additive and at higher extents of reaction, the product appeared similar to urea. These differences are being investigated further.

965 **(LA-UR—83-2886) Flame fronts with complex chemical networks.** Fife, P.C.; Nichols, B. (Arizona Univ., Tucson (USA); Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 38p. (CONF-8305110—4). NTIS, PC A03/MF A01. Order Number DE84001175.

From Fronts, interfaces and patterns conference; Los Alamos, NM, USA (2 May 1983).

For laminar flame fronts with general complex chemistry networks, we present a systematic method to reduce the detailed chemistry in the limit of high-activation-energy asymptotics. We detail the method on a global multistep hydrocarbon model. Generic flame profile structures are discussed, and extensions to networks with zero activation energies are outlined.

966 (LBL—15298, pp 4.52-4.54) **Theoretical and experimental studies of reactions important in combustion.** Brown, N.J.; Miller, J.A.; Rashed, O.M. (Sandia National Laboratories, Livermore, CA). Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Topics covered include: theoretical and experimental studies of reactions important in combustion, numerical modeling of turbulent combustion, controlled combustion, heat and mass transfer with combustion, flame propagation, measurement of combustion enerated pollutant species, combustion in a turbulent boundary layer, turbulent burning velocity in premixed turbulent flames, plasma ignition studies, structure of a v-shaped turbulent flame, and tests and criteria for fire protection of cable penetrations and electrical cabinets.

967 **(SAND—83-8244) Fundamental combustion and diagnostics research at Sandia. Progress report, January-March 1983.** Gusinow, M.A. (ed.). (Sandia National Labs., Livermore, CA (USA)). Oct 1983. Contract AC04-76DP00789. 52p. NTIS, PC A04/MF A01. Order Number DE84001787.

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The Department of Energy/Office of Basic Energy Sciences, through the Division of Chemical Sciences/Fundamental Interactions Branch, has established a Combustion Research Facility at Sandia National Laboratories, Livermore, California. The long-term research carried out at this Facility emphasizes fundamental studies which have the potential to impact practical combustion. A special emphasis is given to the development and application of advanced research methods, taking advantage of the latest progress in laser and computer technologies. Included here are quarterly reports on the research sponsored by the Division of Chemical Sciences/Fundamental Interactions Branch. The first section presents progress on flame research; the second section details research in combustion chemistry and modeling; the third section describes results in diagnostics research; and the fourth section provides technical highlights on resources developed and made available at the Combustion Research Facility.

968 **Chemical thermodynamic analysis of the interaction of 304 stainless steel with the gases and the $CaSO_4$ deposit in the fluidized-bed combustor.** Lindemer, T.B.; Pearson, R.L. (Oak Ridge National Lab., TN (USA)). *High Temperatures - High Pressures;* **14**: No. 5, 581-591(1982). (CONF-810943—).

From Conference on chemistry of materials at high temperatures; Harwell, Oxfordshire, UK (7 Sep 1981).

Recently developed thermodynamic techniques are applied to a theoretical analysis of the corrosion of heat-exchanger tubes in the fluidized-bed coal combustor. These techniques permit determination of the equilibrium phases at any location, or series of locations, in a reaction zone from two sets of data. One set is the aggregate elemental composition at any position in the interface, The second is the value of the Gibbs free energy of formation for each of the condensed and gaseous species that could conceivably exist in the system. Analysis of the subject system at the Fe-Cr-Ni-Mn composition of type 304 stainless steel (304 SS) suggests that the presence of a $CaSO_4$ deposit on 304 SS is a sufficient condition for reactions that produce oxides and sulfides. Formation of Ni_3S_2 in the reaction zone is indicated, from which can be inferred the presence of the deleterious 910 K Ni-liquid-Ni_3S_2 eutectic, as has been suggested from experimental work. The presence of $CaFe_2O_4$ spinel is found here to be necessary for the formation of sulfides of manganese and iron which are observed experimentally.

42 ENGINEERING

969 **27th annual meeting of the American Association of Cost Engineers.** Humphreys, K.K.; Humphreys, B. (eds.). Morgantown, WV; American Association of Cost Engineers (1983). 330p. (CONF-8306123—). American Association of Cost Engineers, 308 Monongahela Building, Morgantown, WV 26505-5468.

From 27. annual meeting of the American Association of Cost Engineers; Philadelphia, PA, USA (26 Jun 1983).

The technical program was organized into six concurrent sessions - composed of technical papers, technical panel discussions, and workshops sponsored by the various technical committees of the AACE. From a total of 64 papers, a separate abstract was prepared for each of 12 individual presentations.

4201 General Engineering

970 **(BDX—613-294) Solid modeling by SynthaVision: means of reducing tooling and unit cost for investment castings.** Cromwell, W.E. (Bendix Corp., Kansas City, MO (USA)). Sep 1983. Contract AC04-76DP00613. 26p. (CONF-830928—2). NTIS, PC A03/MF A01. Order Number DE84002421.

From 9. ASME biennial conference on mechanical vibration and noise; Dearborn, MI, USA (12 Sep 1983).

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For many years, users of investment castings have obtained quotations from producers by submitting detailed design drawings. These producers (or suppliers) normally are required to respond with formal quotations within a relatively short time. Many suppliers sub-contract the designing and building of the required wax pattern die and associated casting tooling to various outside tool shops. Past experience indicates that tooling producers may inflate their quoted prices for tooling to cover possible oversights caused by the limited time given to review complex casting designs and to formulate firm tooling quotations. Approximately three years ago, information was acquired on a relatively new developing technology related to a three-dimensional solid modeling program called SynthaVision. While considering possible applications for this new technology, it became apparent that such a visual aid concept might be of some possible cost avoidance benefit in the procurement of precision castings. Therefore, it was decided to actively employ the use of SynthaVision on some new Bendix casting requirements.

971 **(SAND—83-1506) Tape joint design guidelines.** Rechard, R.P.; Black, J.T. Jr.; Meyer, S.D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1983. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01. Order Number DE84002052.

Connections joining cylindrical cases are required in applications ranging from pipelines to rocket bodies. The tape joint exceeds in versatility most other joints in these applications. It is strong in both bending and axial loading; easy to design, analyze, fabricate, and assemble; and space-efficient and lightweight. The vital features of the tape joint (interlocking tabs and offset tape grooves) and the assembly procedure are discussed. Important dimensions (tape groove depth, area above and below the tape tunnel, length separating tape tunnel and interlocking tabs, and throat length) and specifications necessary for the ensured success of the joint are explained. A 12-step design procedure follows in a separate, easily referenced section. Finally, application examples are presented that show the details associated with tolerancing. Examples of possible modifications also are shown to demonstrate the versatility of the tape joint.

972 **(LA-tr—83-20) Study by measurements of electrical resistance of the repartition of pressures within a disordered stack of spheres.** Giraud, G.; Clerc, J.P.; Guyon, E. Translated from *Powder Technology ;* 35: 107-111(1983). Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

Measurement of the conductivity of a mixture of conducting and insulating spheres (submitted to pressure) is used to characterize the repartition of the contacts between spheres. The results obtained for different dispositions of probes are interpreted in terms of percolation. For these mixtures, we show that the transmission of pressure is not hydrostatic: an arching process is obtained. The average number of contacts is more important in this arch than in the other parts of the sample.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 667, 779, 890, 1688

973 **(AD-A—130317/1) Dynamic cylinder test program. Technical paper.** Stephens, J.E. (Air Force Ballistic Missile Office, Norton AFB, CA (USA)). 29 Jun 1983. 39p. NTIS, PC A03/MF A01.

The response of buried horizontal MX missile shelters to simulated nuclear airblast and airblast induced ground shock loadings is investigated. Two tests were conducted on scaled reinforced concrete models to examine the effect of structural variations on shelter response and to characterize the loadings across the shelter soil interface. Pretest calculations were performed for each test. The effectiveness of the calculation techniques was evaluated through comparison of the test and predicted results.

974 **(AD-A—130318/9) Laboratory investigation of expansion, venting, and shock attenuation in the MX trench. Technical paper.** Gran, J.K.; Bruce, J.R.; Colton, J.D. (SRI International, Menlo Park, CA (USA)). 29 Jun 1983. 25p. NTIS, PC A02/MF A01.

An experimental program using 1/26-scale models of a buried concrete trench was conducted to study the dynamics of expansion and venting caused by an airblast propagating down the trench, and to study the effects of the expansion and venting on the attenuation of the airblast. The trench models were made of steel fiber-reinforced concrete and were buried in sand. The airblast was produced with an explosively driven shock tube. Expansion and venting dynamics of short trench sections were studied for flat-topped pressure pulses ranging from 700 psi to 2600 psi. Radial expansion histories and vent-times were recorded. Shock attenuation was studied with 60-ft-long trenches in which the peak pressure of an exponential waveform decreased from 4000 psi to 300 psi as the shock propagated the length of the trench. The effects of expansion were isolated by comparing the attenuation in a concrete trench to that in a steel trench. Expansion reduced the peak pressure slightly at distances greater than 40 ft. The data were used to validate computer models for shock attenuation in the MX trench.

975 **(AD-A—130319/7) 1/5 size vhs series blast and shock simulations. Technical paper.** Noble, M. (Air Force Ballistic Missile Office, Norton AFB, CA (USA)). 29 Jun 1983. 31p. NTIS, PC A03/MF A01.

The simulation objective of the 1/5 Verifiable Horizontal Shelter (VHS(test series was to demonstrate the capability of a High Explosive Simulation Technique (HEST) simulator to adequately duplicate complex airblast waveform loadings. A principal feature of the HEST design was the requirement to produce double-peaked resultant overpressures. The modeling baseline was established by a test (D-1) producing dynamic flow. The HEST test (Sh-1) comparably matched the loading waveforms both in relative magnitude and phase chracteristics. The HEST simulator has proven its utility for both multiple shock effects and multi-pressure loadings on reflection and drag sensitive structures.

976 **(AD-A—130322/1) Comparison of nuclear simulation techniques on generic MX structures. Technical paper.** Betz, J.F. (Air Force Contract Management Div., Los Angeles, CA (USA)). 29 Jun 1983. 26p. NTIS, PC A03/MF A01.

A HEST (High Explosive Simulation Technique) is as good a simulator of an airblast environment as a DABS (Dynamic Airblast Simulator). A study performed on the results of two identical 1/5 scale protective structures when tested under matching environments produced by each of the simulators revealed data which supports the viability of the HEST simulator, which is less costly and was thought to be of less fidelity than a DABS simulation. Structural response data, which is used as a yardstick to compare simulators, shows identical response modes are produced by the two simulators as arranged in the matching tests.

977 **(AD-A—130325/4) Testing of reduced-scale concrete MX-shelters experimental program. Technical paper.** Daniel, J.I.; Schultz, D.M. (Air Force Ballistic Missile Office, Norton AFB, CA (USA)). 29 Jun 1983. 25p. NTIS, PC A02/MF A01.

An experimental program involving construction and testing or reduced-scale concrete horizontal MX-Missile Shelters was conducted. The program consisted of 43 shelter specimens tested under static laoding conditions. Applied loads modeled forces that might occur on the shelters from a nearby nuclear weapon attack. Loads consisted of various combinations of nonuniform radial surface pressure and axial thrust. Loads, deformations, and reinforcement strains were measured. Strength and ductility of specimens were determined. Test results were used to analyze shelter behavior

under known loading conditions and to assist in selection of feasible shelter candidates for design.

978 **(AD-A—130326/2) Testing of reduced-scale concrete MX-shelters specimen construction. Technical paper.** Ciolko, A.T. (Air Force Ballistic Missile Office, Norton AFB, CA (USA)). 29 Jun 1983. 25p. NTIS, PC A02/MF A01.

An experimental program involving construction and testing or reduced-scale concrete Horizontal MX-Missile Shelters was conducted. This paper describes the construction of 43 reduced-scale cement models of the Shelters. Twenty-two different prototypes were constructed. All specimens had a 2-ft (0.61 M) inside diameter with plain or reinforced concrete walls 1.8 (46 mm) or 2.4-in. (61 mm) thick. Specimen test length was 4 ft (1.22 m) with 1 ft (0.30 m) at each end for load transfer. Variables in specimen construction included wall thickness, amount of reinforcing, breakout joints details, liner thickness, spacing of studs, and Z-insert gap of the SAL inspection panel. Sensitivity of test results to variations in specimen dimensions required unusually rigid tolerances. In spite of manufacturing complexities, specimens were manufactured at a rate of three per week.

979 **(AD-A—130327/0) Use of physical models in development of the MX protective shelter. Technical paper.** Sevin, E. (Air Force Ballistic Missile Office, Norton AFB, CA (USA)). 29 Jun 1983. 28p. NTIS, PC A03/MF A01.

The design candidate M-X protective shelters made extensive use of engineering data developed from tests on physical models. This paper describes the effort associated with structural hardening of the three principal M-X shelter concepts: Horizontal Shelter, Vertical Shelter, and Shallow Buried TRench. Primary emphasis was on the trench concept in which a highly coordinated program of theory and experiment provided the data base for (1) characterization of the airblast loading within the trench structure (i.e., shallow buried tube), (2) feasibility determination of blast plug concepts, and (3) developing a minimum cost design for the hardened shallow buried tube. The experimental activities supporting this effort included laboratory and field shock tube testing, high explosive field testing, and an underground nuclear test. Most innovative, from a structural enginneering perspecitve, was the modeling of (1) coupled airblast and ground shock loading and damage-level response of shallow buried fiber-reinforced concrete tubes, (2) expansion and venting of the tube under internal airblast loading, and (3) coupled flow-structural response of the plug/tube system.

980 **(AD-A—130328/8) Finite element dynamic analysis of the dct-2 model. Technical paper.** Bingham, B.L. (Air Force Contract Management Div., Los Angeles, CA (USA)). 29 Jun 1983. 28p. NTIS, PC A03/MF A01.

This report discusses quasi three-dimensional finite element dynamic analysis performed for a buried reinforced concrete cylindrical shell explosive test conducted by AFWL at Kirtland AFB, NM. The test (conducted on 27 Feb 81) included two horizontal ICBM shelter models with rectangular roof cut-outs, inner steel liners, longitudinal interior rails, and two different thickness to inner radius ratios (0.18 and 0.28). Both models were subjected to a combined axial and transverse simulated nuclear environment. The finite element analysis examines the axial response to include the initial compressive wave, structure-media interaction loads, longitudinal vertical bending, axial strains and motion, and effects of certain structural details such as rectangular roof cutouts and varying thickness to internal radius ratio. The reinforced concrete material model is piecewise linear, perfectly plastic with smeared steel.

981 **(DOE/ER/10692—T1) 4.0K cryocooler project. Final report.** Paulson, D.N.; Sager, R.E. (S.H.E. Corp., San Diego, CA (USA)). 30 Sep 1983. Contract FC03-80ER10692. 80p. NTIS, PC A05/MF A01. Order Number DE84000332.

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Explicit calculations on the regenerative, shuttle, conduction, and viscous losses to be expected in a nonmagnetic cryocooler were performed. Materials were identified and tested which would be suitable for use in the low temperature parts of the cooler. A preliminary system for a cryocooler test station and an advanced system for the advanced prototypes cryocooler were designed. A thermal isolation apparatus, or dewar, was designed and fabricated. A single stage Stirling cylinder in a cryocooler configuration was designed, constructed, and tested. It was found that adding ^3He as the working fluid to one configuration improves performance. The problem of building the static ^4He regenerator is addressed. A Malone style stage was designed, constructed, and tested. The magnetic and vibrational signature of the operating cryocooler was measured with an external magnetometer and gradiometer. System reliability is summarized. (LEW)

982 **(DP-MS—83-43) Laboratory robotics systems at the Savannah River Laboratory.** Dyches, G.M.; Burkett, S.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 28p. (CONF-831198—1). NTIS, PC A03/MF A01. Order Number DE84001760.

From Eastern analytical symposium; New York, NY, USA (16 Nov 1983).

Many analytical chemistry methods normally used at the Savannah River site require repetitive procedures and handling of radioactive and other hazardous solutions. Robotics is being investigated as a method of reducing personnel fatigue and radiation exposure and also increasing product quality. Several applications of various commercially available robot systems are discussed involving cold (nonradioactive) and hot (radioactive) sample preparations and glovebox waste removal. Problems encountered in robot programming, parts fixturing, design of special robot hands and other support equipment, glovebox operation, and operator-system interaction are discussed. A typical robot system cost analysis for one application is given.

983 **(N—8327876) Thermal conductance of pressed contacts at liquid helium temperatures.** Salerno, L.J.; Kittel, P.; Spivak, A.L. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). May 1983. 8p. (NASA-TM—84365). NTIS, PC A02/MF A01.

The thermal contact conductance of a 0.4 micrometer surface finish OFHC copper sample pair has been investigated from 1.6 to 3.8 K for a range of applied contact forces up to 670 N. Experimental data have been fitted to the relation for the integral alpha T to the nth power dt by assuming that the thermal contact conductance is a simple power function of the sample temperature. It has been found that the conductance is proportional to T squared and that conductance increases with an increase in applied contact force. These results confirm earlier work.

984 **(SAND—83-1636C) New, high performance rotating parachute.** Pepper, W.B. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 12p. (CONF-8304129—3). NTIS, PC A02/MF A01. Order Number DE84002382.

From 8. AIAA conference on aerodynamic decelerator and balloon technology; Hyannis, MA, USA (2 Apr 1983).

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A new rotating parachute has been designed primarily for recovery of high performance reentry vehicles. Design and development/testing results are presented from low-speed wind tunnel testing, free-flight deployments at transonic speeds and tests in a supersonic wind tunnel at Mach 2.0. Drag coefficients of 1.15 based on the 2-ft diameter of the rotor have been measured in the wind tunnel. Stability of the rotor is excellent.

985 **(UCRL—53377-Rev.1) Design and testing of Type A containers for packaging radioactive waste. Revision 1.** Perkins, C.L. (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01. Order Number DE84001929.

The Toxic Waste Control Group at the Lawrence Livermore National Laboratory tested numerous Type A containers for use in the shipping of retrievable and disposable radioactive waste, specifically Transuranic waste, to identify and adopt a container that meets test criteria established by the Department of Transportation (49 CFR 173.398). This report summarizes the test results. Several containers passed DOT tests, but were unacceptable for use

because of cost, maneuverability, size or shape, weight, or potential fire hazard during closure. The TX-4 passed all DOT tests and met LLNL requirements for handling, safety, and cost.

986 **(UCRL—89739) Compliance check on Japax electrical-discharge-wire machine.** Martinez, J. (Lawrence Livermore National Lab., CA (USA)). 15 Jun 1983. Contract W-7405-ENG-48. 14p. (CONF-8306132—1). NTIS, PC A02/ MF A01. Order Number DE84001430.

From Interagency manufactiring operations group meeting; Denver, CO, USA (15 Jun 1983).

Portions are illegible in microfiche products.

The report describes the checkout of a wire Electrical Discharge Machine at a factory in Japan, specifically of the mechanicl accuracy of parts. (LEW)

987 **(Y/OA—2724) Cargo-restraint-transporter: a proven method of handling drum-type containers on safe-secure trailers.** Ramsey, W.E.; Burger, T.N. (Oak Ridge Y-12 Plant, TN (USA)). 1983. Contract W-7405-ENG-26. 9p. (CONF-830528—61). NTIS, PC A02/MF A01. Order Number DE84002418.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The introduction of Cargo-Restraint-Transporters (CRTs) into the DOE transportation system has proven to be very successful and cost effective. The future looks good for the CRT; and, hopefully, the next generation of CRTs will be even more adaptable for solving unique shipping and handling problems associated with shipping a wide variety of containers on the Safe-Secure Trailers (SSTs). The following are just a few of the benefits that the CRTs have generated: standardization of loading and tie-down techniques; cost savings in more efficient use of loading personnel; cost savings in the transportation group by reducing the time the SSTs are idle at the loading docks; and improved quality assurance of containers and contents.

988 **Radio-frequency amplifier based on a dc superconducting quantum interference device.** Hilbert, C.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **43**: No. 7, 694-696(1 Oct 1983). Contract AC03-76SF00098.

A dc superconducting quantum interference device used as a radio-frequency amplifier has achieved a power gain of 19.5 +- 0.5 dB and a noise temperature of 1.0 +- 0.4 K at a frequency of 100 MHz and an operating temperature of 1.5 K.

989 **Continuous chain bit with downhole cycling capability.** Ritter, D.F.; St. Clair, J.A.; Togami, H.K. (to US Dept. of Energy). US Patent 4,394,882. 26 Jul 1983. Filed date 17 Mar 1981. vp.

PAT-APPL-244573.

A continuous chain bit is disclosed for hard rock drilling which is capable of downhole cycling. A drill head assembly moves axially relative to a support body while the chain on the head assembly is held in position so that the bodily movement of the chain cycles the chain to present new composite links for drilling. A pair of spring fingers on opposite sides of the chain hold the chain against movement. The chain is held in tension by a spring-biased tensioning bar. A head at the working end of the chain supports ther working links. The chain is centered by a reversing pawl and piston actuated by the pressure of the drilling mud. Detent pins lock the head assembly with respect to the support body and are also operated by the drilling mud pressure. A restricted nozzle with a divergent outlet sprays drilling mud into the cavity to remove debris. Indication of the centered position of the chain is provided by noting a low pressure reading indicating proper alignment of drilling mud slots on the links with the corresponding feed branches.

990 **A four-layer, two-inch bore, superconducting dipole magnet.** Hassenzahl, W.; Gilbert, W.; Meuser, R.; Peters, C.; Taylor, C. (Lawrence Berkeley Lab, University of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 1389-1393(May 1983). Contract AC03-76SF00098.

Two superconductors can be considered for a 10 T accelerator. The first is Nb_3Sn, which can operate at 10 T at about 4.4 K, and the second is NbTi, which must operate in superfluid helium at 1.8 K to achieve 10 T. Several different designs were considered for these magnets and two were selected as the basis for a model testing program. The one described here, the cylindrical layer design, was selected because of the experience with this type of winding in the ESCAR, the Fermilab Doubler/ Saver, the Brookhaven ISABELLE magnets, and the recent results in the development and testing of model magnets at LBL. A somewhat similar design was described by Ishibashi and McInturff. The 50 mm (2") bore was selected for these models to minimize costs. This program to develop 10 Tesla coils includes perfecting the 4 layer design including fabrication and assembly and developing a suitable conductor. The general conductor type selected is a Rutherford cable of approximately the width of the FNAL cable. To achieve 10 T in 4 layers with NbTi at 1.8 K requires an efficient coil design with graded conductor and a copper to superconductor ratio of about 1. The authors are now developing suitable graded cable. However, they used the cable with the lowest copper-tosuperconductor ratio available, 1.5, in the model dipoles described here. The current density is the same in all four layers.

991 **Ramp rate sensitivities of several superconducting dipole magnets operated in HE I and HE II.** Caspi, S.; Gilbert, W.; Rechen, J. (Lawrence Berkeley Lab, University of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 1394-1397(May 1983). Contract AC03-76SF00098.

The quench current of a superconducting dipole magnet decreases from its slow-ramp value as the current ramp-rate is increased, due to heat buildup in the coil winding. This ramp-rate dependence has been measured for several superconducting dipoles in both normal He I and in superfluid He II. The heat generated by changing fields has been measured for several magnets in He II, where particularly sensitive and accurate measurements can be made of any heat input to the essentially isothermal helium bath by its temperature rise. Previously measured values of heat transfer are applied to the data from one magnet to explain its observed behavior. The conclusion is drawn that at a given cycle rate, a superfluid He II-cooled superconducting accelerator can operate closer to the short-sample limit of the magnet's superconductor than can a corresponding He I-cooled machine.

992 **Design of a 10-T superconducting dipole magnet using niobium-tin conductor.** Taylor, C.; Caspi, S.; Gilbert, W.; Hassenzahl, W.; Meuser, R.; Peters, C.; Schafer, R.; Wolgast, R. (Lawrence Berkeley Lab, University of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 1398-1400(May 1983). Contract AC03-76SF00098.

In order to minimize the size and cost of conventional facilities -- land, tunneling, shielding, cryogenic and vacuum system -- the dipole magnets for the next generation of particle accelerators must produce as strong a magnetic field as possible. Ten tesla seems to be a reasonable goal, and can be attained by using either niobium-tin conductor at 4.2 K or niobium-titanium at 1.8 K. The beam diameter in a multi-TeV accelerator, can in principle, be quite small, say 20 mm, depending on the design of the injection and extraction systems, and on beam-cooling technology. Magnet cost is strongly dependent on bore diameter, so there is a strong incentive to minimize that. The authors believe that a 40-mm bore diameter -- about 60-mm winding inside diameter is feasible and is a reasonable goal for initial research and development. For such a high field and small bore, there is an incentive to achieve a high overall current density in order to minimize the amount of superconductor. The authors' design is based on an overall current density of 400 A/sq mm.

993 **Superconducting critical current densities of pure and alloyed (Ti) Nb_3Sn multifilamentary wires by the expanded-metal process.** Svenaga, M.; Klamut, C.; McDonald, W. (Brookhaven Nat'l Lab, Upton, NY). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 1425-1428(May 1983).

The critical current densities J /SUB c/ (H) at 4.2 K and up to 19 T were measured for a number of pure and alloyed (with Ti) Nb_3Sn multifilamentary wires which were fabricated by the expanded metal process. The critical current density (including the areas of Nb_3Sn, the Cu-Sn alloy matrix and the Ta barrier) of the pure Nb_3Sn wire at 10 T was essentially equal to the value for conventionally processed Nb_3Sn wires. However, it rapidly decreased with increased magnetic fields. Although the addition of small amounts (about 0.8 and about 1.6 wt% Ti) to the Nb filaments decreased the values of J /SUB c/ at 10 T, they did not decrease with the increasing field as rapidly as is the case for the pure Nb_3Sn. The additions of Ti slightly decreased the amount of tensile strain on the wire required to achieve a maximum in J /SUB c/ (8 T) when compared to that required for the pure /SUP c/ Nb_3Sn. However, this amount was higher than that for a similar Nb_3Sn wire which was conventionally processed.

994 **Fault current limiter using a superconducting coil.** Boenig, H.; Paice, D.A. (Los Alamos Nat'l Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 1051-1053(May 1983).

A novel circuit, consisting of solid-state diodes and a biased superconducting coil, for limiting the fault currents in three phase ac systems is presented. A modification of the basic circuit results in a solid-state ac breaker with current limiting features. The operating characteristics of the fault current limiter and the ac breaker are analyzed. An optimization procedure for sizing the superconducting coil is derived.

995 **Short circuit detection in the winding and operation of superconducting magnets.** Walstrom, P. (Oak Ridge Nat'l Lab, Oak Ridge, TN 37830). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 1094-1096(May 1983). Contract W-7405-ENG-26.

When a superconducting magnet with a shorted turn or turns is rapidly discharged, the changing magnetic flux can drive large currents through the short. These currents can lead to local temperature rises, to melting of the conductor and failure of insulation, and finally to destruction of the magnet. It is, therefore, highly desirable to detect and remove shorts during the manufacture of coils.

996 **The design approach and innovations for the largest, uniform field, superconducting solenoid magnet.** Danninger, G.; Lieurance, D.; Walker, D. (General Dynamics Convair Div., Energy Systems, P.O. Box 80877, San Diego, CA 92138). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 872-875(May 1983).

Design, development, manufacture, and acceptance testing of the Preprototype Magnet System (PMS) was undertaken in April 1978 under contract with the TRW Energy Systems Group as sponsored by DOE for Advanced Isotope Separation System Development. The PMS began operation in September 1981. The principal design requirement was to provide a uniform magnetic field of 20,000 gauss + or - 0.1% for a 5-meter-long by 0.75-meter-diameter test region. The paper presents the magnet design, manufacturing and in-process test approach taken to meet this requirement. This includes the development of equipment and techniques for ensuring winding integrity and the method of achieving field uniformity during manufacture. Design innovations for coil cryostat components are also presented. These include 1) the cold mass support strut, which was redesigned from a previously proven configuration due to manufacturing scaling problems, 2) the thermal shield, which was simplified from the previous full-flow configuration, 3) the layer-to-layer insulation configuration, which must provide for sufficient LHe circulation, and 4) the coil overbanding configuration, which prevents conductor movement when the coil is energized.

997 **Fabrication of 20 KA, 12 Tesla conductor using external bronze process MF Nb_3Sn.** Schwall, R.; Ozeryansky, G. (Intermagnetics General Corp., P.O. Box 566, Guilderland, NY 12084). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 920-922(May 1983).

A MF Nb_3Sn cabled conductor with a design critical current in excess of 20 KA has been delivered to the Oak Ridge National Laboratory for stability test in the CWTX Facility. The 5.2 cm x 1.1 cm conductor, an adaptation of a 12 Tesla ETF design, is a 7 x 7 x 3 x 16 cable. The seven strand primary cables incorporate two 0.3 mm diameter external bronze process MF Nb_3 Sn strands and five barrier protected stabilizer strands. Critical current density in the active strands is approximately 5×10^4 A/cm^2 at 12 Tesla, 4.2 K.

998 **Status reports on Isabelle magnets.** Palmer, R.; Baggett, N.; Dahl, P. (Brookhaven National Lab, Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 189-194(May 1983).

The design of the ISABELLE "Palmer" magnets is described. The performance of thirteen such magnets is reported. Average quench fields of 55 kG at 4.5°K have been obtained with essentially no training. The magnets can be shown to be limited only by the short sample characteristics of the cable. Required field quality was achieved in the last four magnets.

999 **Status of the energy saver.** Orr, J. (Fermi National Accelerator Lab., Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 195-197(May 1983).

The one-TeV proton synchrotron which has been under construction at Fermilab is nearly complete and is now entering the commissioning phase. The assembly and testing of the ring of more than 1000 superconducting magnets with its associated cryogenic, vacuum, power, R.F., controls and safety systems has gone extremely well.

1000 **The effect of field orientation on current transfer in multifilamentary superconductors.** Goodrich, L. (National Bureau of Standards, Boulder, CO 80303). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 244-247(May 1983).

Experimental data and discussion are presented on the current distribution along the length of a superconducting wire when subjected to multiple parallel and perpendicular magnetic fields. The experimental data were taken on a rectangular pancake coil with the applied magnetic field in the plane of the coil. These data indicate that significant current transfer occurs in the first and last perpendicular magnetic field sections and little transfer occurs between these two sections. The implication for superconducting magnet design will also be discussed.

1001 **Extending an internally cooled superconducting magnet to higher fields.** Lue, J.; Miller, J. (Oak Ridge National Lab, Oak Ridge, TN 37830). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 261-263(May 1983). Contract W-7405-ENG-26.

An internally cooled superconducting (ICS) magnet was built and tested earlier at Oak Ridge National Laboratory (ORNL), and its stability margin as a function of operating fields was measured at an ambient helium temperature of 4.2 K. In the experiment reported here, the authors retested this magnet with lower bulk helium temperatures. The stability margins of the magnet as a function of temperature were measured. The results demonstrate clearly the flexibility offered by an ICS magnet: The stability margin can be improved substantially or the field output can be extended without sacrificing the stability margin simply by feeding the magnet with lower temperature helium. The analysis made in a previous paper on extended field operation of an ICS magnet is thus confirmed.

1002 **Geophysical applications of squids.** Clarke, J. (Dept. of Physics, Univ. of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 288-294(May 1983). Contract AC03-76SF00098.

Present and potential geophysical applications of Superconducting Quantum Interference Devices (SQUIDs) include remote reference magnetotellurics, controlledsource electromagnetic sounding, airborne gradiometry, gravity gradiometers, rock magnetism, paleomagnetism, piezomagnetism, tectonomagnetism, the location of hydrofractures for hot dry rock geothermal energy and enhanced oil and gas recovery, the detection of internal ocean waves, and underwater magnetotellurics.

1003 **Comparative evaluation of existing concepts for a 10 tesla FED toroidal field coil.** Chen, W.; Alcorn, J.; Purcell, J. (General Atomic Company, P.O. Box 81608, San Diego, CA 92138). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 328-333(May 1983). Contract AT03-76ET51011.

The existing design concept options for FED toroidal field coils have been studied and evaluated by General Atomic Company as part of the FED/INTOR Critical Magnetic Issues effort for 1982. The various design concepts studied are: (1) forced flow cooled NbTi cabled conductor, (2) He-II bath cooled Nb_3Sn-NbTi hybrid with cabled conductor. These design concepts are evaluated based upon their relative merits, including technological maturity, operational reliability, overall reactor compatability, maintainability, and cost. An important aspect of this study was the normalization of each design concept to meet similar operational requirements. The critical issues in the TF coil design, including the structural role of the helium vessel, quench protection, accommodation of neutronic and eddy current heating, credible fault criteria, and the possibility of prototype coil demonstration are discussed. The consequences and implications of extending the peak field in the range from 8 to 10 tesla was also studied.

1004 **Superconducting magnets for gyrotron tubes.** Hsu, Y.; Prater, R.; Purcell, J. (General Atomic Company, San Diego, CA 92138). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 365-367(May 1983). Contract AT03-76ET51011.

Six superconducting magnet systems have been designed and built for gyrotron tubes furnished by Varian. The systems are being installed on the General Atomic Doublet III Tokamak Fusion Device for radio frequency heating. They will initially operate at 60 GHz requiring a 2.5 T field, but the magnets can be operated to 5 T for possible upgrade to 120 GHz. Key design features include high precision coil winding, high precision coil positioning (concentric with bore), low helium boil-off rate, and a one week operating time without refilling. A low operating current of 7 A for 60 GHz operation was selected for reducing the heat leak through the power leads. Aluminum tape and superinsulation are utilized to decrease the radiation heat leak. The overall dimensional constraint makes it difficult to keep the helium boil-off rate very low. Two systems have been operated with 60 GHz gyrotron tubes. The tubes have been brought up to full power and the performance of the magnet is satisfactory. The average liquid helium boil-off rate is 0.4 l/hr, i.e., liquid helium will last for six days without refilling. The liquid nitrogen cooled thermal shield must be refilled every three days. The detailed design, construction, and testing results are presented.

1005 **Sliding-gate valve for use with abrasive materials.** Ayers, W.J. Jr.; Carter, C.R.; Griffith, R.A.; Loomis, R.B.; Notestein, J.E. US Patent Application 6-422,795. 24 Sep 1982. 12p.

The invention is a flow and pressure-sealing valve for use with abrasive solids. The valve embodies special features which provide for long, reliable operating lifetimes in solids-handling service. The valve includes upper and lower transversely slidable gates, contained in separate chambers. The upper gate provides a solids-flow control function, whereas the lower gate provides a pressure-sealing function. The lower gate is supported by means for (a) lifting that gate into sealing engagement with its seat when the gate is in its open and closed positions and (b) lowering the gate out of contact with its seat to permit abrasion-free transit of the gate between its open and closed positions. When closed, the upper gate isolates the lower gate from the solids. Because of this shielding action, the sealing surface of the lower gate is not exposed to solids during transit or when it is being lifted or lowered. The chamber containing the lower gate normally is pressurized slightly, and a sweep gas is directed inwardly across the lower-gate sealing surface during the vertical translation of the gate.

1006 **American National Standard: for nuclear criticality control of special actinide elements.** La Grange Park, IL; American Nuclear Society (1981). 23p. (ANSI/ANS—8.15-1981). American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525 $25.00.

This standard is applicable to operations with the following: ^{237}Np, ^{238}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, /sup 242m/Am, ^{243}Am, ^{243}Cm, ^{244}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cf and ^{251}Cf. Subcritical mass limits are presented for isolated fissionable units. The limits are not applicable to interacting units.

4203 Lasers

REFER ALSO TO CITATION(S) 860, 865, 1137

1007 **(AD-A—130223/1) Continued investigation of the atomic physics of flashlamp pumped cesium-neon lasers. Final report.** Chang, C. (Beers Associates, Inc., Reston, VA (USA)). May 1983. 35p. NTIS, PC A03/MF A01.

In the present report, we are primarily concerned wtih atomic processes in a high pressure gas discharge. The theoretical endeavour is highlighted in a detailed calculation of spectral line profile, which are essential to meaningfully model an arc lamp performance. We also examine the effect of neon as a buffer gas in a high pressure cesium discharge tube. Under the condition of comparable cesium and neon pressures, we concluded that neon buffer gas is beneficial to the overall lamp performance.

1008 **(AD-A—130381/7) Theoretical research on charged particle beam and other plasma systems. Final report Apr 81-Apr 82.** (Berkeley Scholars, Inc., CA (USA)). May 1983. 13p. NTIS, PC A02/MF A01.

The research involved the theoretical analysis of charged particle beam and other plasma systems. The major emphasis of the research was on modeling the free-electron-laser (FEL) oscillator. The approach was to utilize a first order description for the evolution of relativistic electron beam pulses in a cavity with an applied wiggler magnetic field to develop a model for the modal electromagnetic energy in a FEL oscillator.

1009 **(DOE/LAR—83/1) Laser research: a current awareness bulletin.** Raleigh, H.D.; Williams, L. (eds.). (USDOE Technical Information Center, Oak Ridge, TN). 30 Oct 1983. 15p. (PB—83901100). NTIS, PC A02/MF A01. Order Number DE84000543.

Laser Research announces on a semimonthly basis the current worldwide information on all aspects of laser research and development, excluding applications. (MOW)

1010 **(IFUSP-P—308) Semiclassical theory of transmission loss in a laser.** Baseia, B.; Nussenzveig, H.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1981. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE83704258.

Conventional laser theory deals with discrete 'cavity modes' and introduces artificial mechanisms to simulate radiation field losses due to beam extraction. A more realistic model of a laser with a transmitting window, previously investigated by Lang, Scully and Lamb, is reanalysed semiclassicaly. In the previous work, the continuous radiation field spectrum was treated as the limit of a discrete but very dense spectrum of modes, and the narrowness of the laser linewidth was attributed to the locking together of these modes. Working entirely within the continuous spectrum, it is found that the treatment is considerably simplified, leading to an explicit solution for single-quasimode operation within the

linear approximation, that exhibits the role of the excitation conditions in the buildup of the laser field. As was pointed out by Lang and Scully, the transmission loss plays the role of an effective noise source, that verifies the fluctuation-dissipation theorem. However, the continuum treatment does not support the mode locking mechanism, but rather the usual explanation of the laser linewidth in terms of gain narrowing. The nonlinear analysis agrees with the main conclusion of Lang, Scully and Lamb that the 'mode amplitude' of the conventional theory should be interpreted as a collective variable, that satisfies the well-known rotating wave Van der Pol oscillator equation. The domain of validity of this result and of the laser quasimode concept depends on an approximation analogous to the Weisskopf-Wigner one, which is well satisfied in the usual situation of very long-lived quasimodes.

1011 **(N—8322582) Studies on lasers and laser devices. Final Report, 1 Apr. 1980-31 Mar. 1983.** Harris, S.E.; Siegman, A.E.; Young, J.F. (Stanford Univ., CA (USA)). Apr 1983. 81p. (NASA-CR—170173). NTIS, PC A05/MF A01.

The goal of this grant was to study lasers, laser devices, and uses of lasers for investigating physical phenomena are studied. The active projects included the development of a tunable, narrowband XUV light source and its application to the spectroscopy of core excited atomic states, and the development of a technique for picosecond time resolution spectroscopy of fast photophysical processes.

1012 **(N—8322587) Designing waveguide couplers for microwave excitation of laser gases.** Shelton, L.C., Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1982. 151p. (AD-A—124666). NTIS, PC A08/MF A01.

The goal here is to develop an analytical model from which a waveguide coupler can be designed. The specific application considered is to use a waveguide coupler to excite a plasma tube inside a wavegide. This application is desirable for use in laser systems. The approach taken is to model the plasma as an equivalent dielectric centered in the secondary waveguide. Standard waveguide analysis techniques are used to find a perturbed propagation constant in what waveguide. Successive approximations are made to the coupled wave equations until a piece-wise linear solution is obtained. This solution gives the field distribution resulting from any arbitrarily chosen coupling geometry. Thus, the distribution for any desired coupling characteristics can be determined in an iterative manner, essentially by trial and error. Preliminary tests were made on couplers designed using the model initial results are promising but inconclusive.

1013 **(UCRL—88705) High gain free electron laser at ETA.** Orzechowski, T.J.; Prosnitz, D.; Halbach, K.; Kuenning, R.; Paul, A.; Hopkins, D.; Sessler, A.; Stover, G.; Tanabe, J.; Wurtele, J. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 9 Feb 1983. Contract W-7405-ENG-48. 16p. (CONF-830314—6). NTIS, PC A02/MF A01. Order Number DE84002001.

From 2. national conference on high power microwave technology; Adelphi, MD, USA (1 Mar 1983).

A single pass, tapered electron wiggler and associated beam transport has been constructed at the Experimental Test Accelerator (ETA) at Lawrence Livermore National Laboratory (LLNL). The system is designed to transport 1 kA of 4.5 MeV electrons with an emittance of 30 millirad-cm. The planar wiggler is provided by a pulsed electromagnet. The interaction region is an oversized rectangular waveguide. Quadrupole fields stabilize the beam in the plane parallel to the wiggler field. The 3 meter long wiggler has a 9.8 cm period. The Free Electron Laser (FEL) will serve as an amplifier for input frequencies of 35 GHz and 140 GHz. The facility is designed to produce better than 500 Megawatts peak power.

1014 **High power pulsed lasers.** Holzrichter, J.F.; Elimerl, D.; George, E.V.; Hunt, J.T.; Simmons, W.W.; Trenholme, J.B. (Lawrence Livermore National Laboratory, University of California, Livermore, CA 94550). *Journal of Fusion Energy;* **2**: No. 1, 5-45(Feb 1982). Contract W-7405-ENG-48.

Pulsed high power lasers can deliver sufficient energy on inertial fusion time scales (0.1-10 ns) to heat and compress DT fuel to fusion reaction conditions. Several laser systems have been examined for application to the fusion problem. Examples are Nd: glass, CO_2, KrF, and I_2, etc. A great deal of developmental effort has been applied to the Nd: glass laser and the CO_2 gas laser systems. These systems now deliver $> 10^4$ J and $> 20 \times 10^{12}$ W to inertial fusion targets. The Nova Nd: glass laser is being constructed to provide $>$ 200 kJ and $\geq 200 \times 10^{12}$ W of 1 μm radiation for fusion experimentation in the mid-1980s. For inertia fusion target gain, $>$ 100 times the laser input, it is expected that the laser must deliver about 3-5 MJ of energy on the 10-20 ns time scale. This paper reviews the developments in laser technology and outlines approaches to construction of a 3-5 MJ driver.

1015 **Lasers in materials processing.** Davis, J.I. (Lawrence Livermore National Laboratory, Livermore, California). *AIChE (American Institute of Chemical Engineers) Symposium Series;* **78**: No. 221, 71-82(1982).

The high cost of laser energy is the crucial issue in any potential laser processing application. It is expensive relative to other forms of energy and relative to most bulk chemicals. The authors point out those factors that have previously frustrated attempts to find commercially viable laser-induced processes for the production of materials. Having identified the general criteria to be satisfied by an economically successful laser process and shown how these imply the laser system requirements, the authors present a status report on the uranium Laser Isotope Separation (LIS) program at the Lawrence Livermore National Laboratory.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 495, 1451

1016 **(ANL/NESC—1018) SLAB: thermal response of a flat plate in a fluid with oscillating temperature.** Poindexter, A.M. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Energy Systems Div.). [nd]. Contract AT02-80CH94049. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049005.

Portions are illegible in microfiche products7,000 (octal) words of memory are required.

SLAB is a subroutine which solves the one-dimensional temperature problem for a solid slab of finite thickness and infinite width and length which is thermally coupled at both faces by constant film coefficient to a fluid with sinusoidally oscillating temperature. SLAB can calculate the temperatures at any arbitrary set of distances from the center plane of the slab at any desired time after a steady periodic temperature wave is established in the solid, the difference between the surface temperature and average temperature in the slab at that time, and the maximum value of the surface-to-average temperature difference during the cycle, as well as the time of occurrence and temperature distributrion at that time. An analytical solution from Carslaw and Jaeger is used to achieve fast execution time and allow arbitrary nodal spacing without loss of accuracy.

1017 **(LA—9836-MS) TVENT1: a computer code for analyzing tornado-induced flow in ventilation systems.** Andrae, R.W.; Tang, P.K.; Gregory, W.S. (Los Alamos National Lab., NM (USA)). Jul 1983. Contract W-7405-ENG-36. 108p. NTIS, PC A06/MF A01. Order Number DE84002289.

TVENT1 is a new version of the TVENT computer code, which was designed to predict the flows and pressures in a ventilation system subjected to a tornado. TVENT1 is essentially the same code but has added features for turning blowers off and on, changing blower speeds, and changing the resistance of dampers and filters. These features make it possible to depict a sequence of events during a single run. Other features also have been added to make the code more versatile. Example problems are included to demonstrate the code's applications.

1018 **(N—8321261) Predictions of the structure of turbulent, particle-laden, round jets.** Shuen, J.S.; Chen, L.D.; Faeth, G.M. (Pennsylvania State Univ., University Park (USA)). Jun 1982. 36p. NTIS, PC A03/MF A01.

Models of gas and particle motion in turbulent, particle-laden, round jets were evaluated using existing measurements of flow structure. Three models were considered: (1) a locally homogeneous flow model, where velocities and turbulent mixing properties of both phases were assumed to be equal, (2) a deterministic separated flow model, where interphase slip was considered but effects of turbulent dispersion were ignored, and (3) a stochastic separated flow model where effects of interphase slip and turbulent dispersion were considered using random sampling techniques. In all three cases, mean and turbulent properties of the continuous phase were found with a well-calibrated k-epsilon model. The locally homogeneous flow and deterministic separated flow models over- and underestimated particle spread and flow development rates, respectively. The stochastic separated flow model, however, yielded satisfactory predictions of flow structure - except at the high particle loadings. Uncertainties in initial conditions for the measurements and possible effects of turbulence modulation by the particles are proposed as the reason for these errors.

4205 Materials Testing

REFER ALSO TO CITATION(S) 810, 1133

1019 **(CONF-8310163—4) Apparent thermal conductivity measurements by an unguarded technique.** Graves, R.S.; Yarbrough, D.W.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01. Order Number DE84001964.

From 18. international thermal conductivity conference; Rapid City, SD, USA (3 Oct 1983).

An unguarded longitudinal heat-flow apparatus for measuring the apparent thermal conductivity (λ/sub a) of insulations was tested with mean specimen temperatures from 300 to 330°K on samples up to 0.91 m wide, 1.52 m long, and 0.15 m thick. Heat flow is provided by a horizontal electrically heated Nichrome screen sandwiched between test samples that are bounded by temperature controlled copper plates and 9 cm of mineral fiber insulation. A determinate error analysis shows λ/sub a/ measurement uncertainty to be less than +- 1.7% for insulating materials as thin as 3 cm. Three-dimensional thermal modeling indicates negligible error in λ/sub a/ due to edge loss for insulations up to 7.62 cm thick when the temperature difference across the sample is measured at the sceen center. System repeatability and reproducibility were determined to be +- 0.2%. Differences of λ/sub a/ results from the screen tester and results from the National Bureau of Standards were 0.1% for a 10-kg/m³ Calibration Transfer Standard and 0.9% for 127-kg/m³ fibrous glass board (SRM 1450b). Measurements on fiberglass and rock wool batt insulations showed the dependence of λ/sub a/ on density, temperature, temperature difference, plate emittance, and heat flow direction. Results obtained for λ/sub a/ as a function of density at 24°C differed by less than 2% from values obtained with a guarded hot plate. These results demonstrate that this simple technique has the accuracy and sensitivity needed for useful λ/sub a/ measurements on thermal insulating materials.

1020 **(DOE/ER/10107—22) MIT miniaturized disk bend test.** Harling, O.K.; Lee, M.; Sohn, D.S.; Kohse, G.; Lau, C.W. (Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.). 23 Sep 1983. Contract AC02-78ER10107. 28p. (CONF-8309170—5). NTIS, PC A03/MF A01. Order Number DE84001275.

From Symposium on the use of nonstandard subsized specimens for irradiated testing; Albuquerque, NM, USA (23 Sep 1983).

Portions are illegible in microfiche products.

A miniaturized disk bend test (MDBT) using transmission electron microscopy specimens for the determination of various mechanical properties is being developed at MIT. Recent progress in obtaining strengths and ductilities of highly irradiated metal alloys is reviewed. Other mechanical properties can also be obtained using the MDBT approach. Progress in fatigue testing and in determination of the ductile-to-brittle transition temperature is reviewed briefly. 11 figures.

1021 **(FRA/ORD—77/34.I) Nondestructive measurement of longitudinal rail stresses: application of the acoustoelastic effect to rail stress measurement. Final report, June 1, 1975-January 31, 1977.** Egle, D.M.; Bray, D.E. (Oklahoma Univ., Norman (USA). School of Aerospace, Mechanical and Nuclear Engineering). Jan 1978. 124p. NTIS.

A technique for the destructive measurement of the average longitudinal stress as a function of depth in short samples of railroad rail has been shown to be feasible. The quantitative agreement between two sets of measurements made with longitudinally oriented strain gages at two different locations on the same rail demonstrate the accuracy of the technique. Disagreement of measurements made with four arm bridges located under the rail head suggest the presence of a biaxial stresses in the rail head. Stress measurements on a 92 lb/yd rail having seen moderate usage show a maximum compressive residual stress of 200 to 250 MN/m² (29 to 36 ksi) at a depth of 6 to 8 mm (0.25 to 0.31 in).

1022 **(FRA/ORD—77/34.II) Ultrasonic pulse propagation in the cold-worked layer of railroad rail. Final report, June 1, 1975-January 31, 1977.** Bray, D.E. (Oklahoma Univ., Norman (USA). School of Aerospace, Mechanical and Nuclear Engineering). Jan 1978. 160p. NTIS.

Thesis.

Ultrasonic pulses propagating along the rolling surface of used railroad rail were observed to have two distinct arrivals. One arrival corresponded to the expected Rayleigh wave. The other, travelling just ahead of the Rayleigh wave, could not be identified as either a pure shear or dilatational wave. An analysis of the material properties in the rail head showed differences between the cold-worked layer on top of the rail and the underlying structure. The observed condition of a low-velocity layer over a high-velocity substructure was found to satisfy the requirements for the propagation of the M_3 (Sezawa) shear wave mode. Experimental data and solutions to the governing wave equation showed that the early arrival was the M_3 mode. The cause of the shear wave velocity reduction in the cold-worked zone was investigated. Results showed that a material texture having the (531) crystallographic plane parallel to the rolling plane and the [112] crystallographic direction parallel to the rail axis was the most probable cause of the velocity reduction.

1023 **(HEDL-SA—2986) Feasibility of thermal NDE methods for Naval thermal spray coatings.** Green, D.R.; Wandling, C.R.; Schmeller, M.D.; Sulit, R.A. (Westinghouse Hanford Co., Richland, WA (USA); Puget Sound Naval Shipyard, Bremerton, WA (USA); Naval Sea Systems Command, Washington, DC (USA)). 24 Oct 1983. Contract AC06-76FF02170. 29p. (CONF-8310196—1). NTIS, PC A03/MF A01. Order Number DE84001463.

From American Society of Nondestructive Testing conference; Dallas, TX, USA (24 Oct 1983).

Thermal spray coatings are widely used to prevent corrosion in metal structures. They are also used to repair and reduce wear in machinery. A feasibility demonstration has shown that infrared-thermal scanning can be applied to nondestructively examine the coating-to-substrate bonds in a variety of thermal spray coatings. Emissivity independent and thermal wave methods must be applied in some cases to eliminate the effects of local differences in surface conditions and coating thickness. Rough-surfaced coatings such as those used in anti-skid applications can have thickness varying from about 0.1 inch (3 mm) at peaks to less than 0.04 inch (1 mm) at valleys. Data showing the feasibility of detecting non-bonds even under such rough coatings is described in this paper. The present work is the first phase of a program to develop a generally applicable emissivity independent thermal NDE scanning system for thermal spray coatings. This work was sponsored by the US Naval Sea Systems Command Materials Research and Development Program. It was directed by the Puget Sound Naval Shipyard which is the lead shipyard for introduction and implementation of industrial thermal spray processes and equipment for Naval applications. High speed, low application cost, high reliability and ease of test interpretation are the prime goals for the final thermal scanning NDE system. The most advanced state-of-the-art methods using thermal wave analysis to make maximum use of the scan information are being incorporated.

1024 **(LLL/M—147) Tenney-14 control program and system: instruction manual.** Crawford, P.C. (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 62p. NTIS, PC A04/MF A01. Order Number DE84002728.

The Tenney Experiment, or Automated Core Test Unit Experiment, was established to allow core test units to be subjected to predetermined temperature cycles in a Tenney Environmental Chamber under computer control, to monitor resistances of electrical components by computer and to take gas samples automatically. Several subroutines in the computer program are general in nature. The subroutines having to do with the electrical resistances, however, are specific to the units being tested - that is, to the electrical components which are to be monitored. The instruction manual uses examples from the first set of test units thermally cycled, monitored, and sampled under computer control. These include a B-83 core test unit and a W-84 core test unit.

1025 **(UCRL—89922) Microwave nondestructive evaluation of composites.** King, R.J.; Stiles, P. (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 11p. (CONF-830811—17). NTIS, PC A02/MF A01. Order Number DE84001777.

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This paper focuses on the use of microwaves to measure the presence of minute amounts of diffused moisture in dielectric materials of which composites are but one example. The presence of such moisture is thought to be a diagnostic indicator of the structural integrity and aging of composites. The chief objective here is to demonstrate the feasibility of using an open-ended coaxial resonator to monitor moisture.

1026 **Volumetric inspection of moderately thick austenitic stainless steels by multifrequency eddy currents.** Scott, G.W.; Dodd, C.V. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37830). *Journal of Nondestructive Evaluation;* 2: No. 1, 23-33(Mar 1981). Contract W-7405-ENG-26.

This paper describes the initial phase of a project to develop eddy-current methods to inspect welds joining sections of austenitic stainless steel pipe having walls up to 13 mm (0.5 in.) thick. The objective of this phase was to demonstrate the feasibility of detecting and characterizing flaws in austenitic stainless steel base metals. These materials and welds present challenging eddy-current problems because of their relatively large thickness and ferromagnetism. Multiparameter analysis shows that a reflection coil probe operated with three discrete driver frequencies and phase detection can locate and size a cracklike defect in a single conductor in the presence of variations in conductor resistivity, permeability, and thickness and in the probe-conductor spacing (liftoff). Experiments were performed with a modular three-frequency instrument. Flat-plate specimens of types 304L and 347 stainless steel machined to 12.7 to 15.9 mm thickness simulated pipe walls; saw-cut slots 10 to 30% of nominal specimen thickness simulated cracklike defects. The same slots were used in duplicate experiments as near-side (directly under the test probe) or far-side (in the face opposite the probe) defects. Flaw detection and characterization capability was demonstrated by a series of experimental measurements fitted to specimen properties by least squares techniques. The quality of the fit determined the expected accuracy of measurement. Comparison of accuracy estimates determined the best choice of operating frequencies. From the 1, 2, 5 sequence of frequencies between 0.5 and 20 kHz, the optimum set of operating frequencies was selected to be 0.5, 2, and 10 kHz. Estimates of measurement accuracy for combined near- and far-side defect cases were: plate thickness, 0.74 mm; probe liftoff, 0.03 mm; defect location (depth of material above defect), 3.48 mm; and defect size (vertical slot depth), 1.09 mm.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 1376

4207 Vacuum Engineering

REFER ALSO TO CITATION(S) 1131

1027 **Net molecular flow conductance of series elements.** Stubblefield, V.E. (McDonnell Douglas Corporation, St. Louis, Missouri 63166). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 1: No. 3, 1549-1552(Jul 1983).

The problem of calculating the total molecular flow conductance of ductwork made up of series connections of elements of known conductance is discussed from the transmission probability point of view. Cases in which there is a discontinuity in cross section between adjacent elements are included. Two criteria for evaluating methods for this calculation are discussed and applied to two such methods. One method, which includes a short procedure for treating discontinuities in duct cross section, is shown to satisfy both evaluation criteria.

1028 **Simple and efficient internal heater for baking vacuum systems.** LeGrand, A.D.; Greene, E.F. (Metcalf Chemical Laboratories, Brown University, Providence, Rhode Island 02912). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 1: No. 3, 1556-1557(Jul 1983).

A simple and convenient method for baking a vacuum system is described which requires less power and shorter bakeout time as compared to conventional baking methods.

1029 **Sample carousel transfer mechanism.** Fearon, D.H.; Helbig, H.F.; Steward, S.A.; Uribe, F.S. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 1: No. 3, 1558-1560(Jul 1983). Contract W-7405-ENG-48.

A carousel transfer system for a UHV surface analysis chamber has been designed and built. (AIP)

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 1134

1030 **(BDX—613-2990) Vapor degreaser/ultrasonic cleaner solvent evaluation. Final report.** Phipps, J.K. (Bendix Corp., Kansas City, MO (USA)). Nov 1983. Contract AC04-76DP00613. 15p. NTIS, PC A02/MF A01. Order Number DE84002015.

An organic solvent with cleaning properties similar to trichloroethylene, but with a lower boiling point and less toxicity, was sought for the vapor degreasing/ultrasonic cleaning of printed circuit boards. For this study, 1,1,1-trichloroethane was investigated because of its similarity in solvency properties and vapor densities. Using either solvent, circuit boards were equal in cleanliness when measured by the evaporative rate analysis technique. Based on this investigation, 1,1,1-trichloroethane was found to meet all criteria as a substitute for trichloroethylene.

1031 **(LA-UR—83-2622) Pulsed-power diode generation of high-power microwaves.** Peratt, A.L.; Mostrom, M.A.; Kwan, T.J.T.; Thode, L.E. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-830911—31). NTIS, PC A02/MF A01. Order Number DE84001344.

From 5. international conference on high power particle beams; San Francisco, CA, USA (12 Sep 1983).

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The generation of microwave radiation at gigahertz frequencies in high-voltage pulsed-power diodes has been investigated with electromagnetic particle simulations. Pulsed power in the form of a

0.5-1.0 MV, TEM wave is fed to the diode via a 5-cm diameter cylindrical stalk onto which a 30-cm diameter cathode has been mounted. Located some 3 to 5 cm in front of the cathode is a foil anode grid. As the TEM wave propagates between the stalk and an outer cylindrical cage (70-cm diameter) a stream of electrons are emitted off the stalk when the local electric field exceeds 200 kV/cm. This flow is then magnetically insulated and confined by the induced B/sub θ/ fields resulting from the 25- to 50-kA current flow within the stalk. Convex shaping of the cathode surface allows the emitted electrons to form a virtual cathode beyond the grid, then phase bunch to produce narrow bandwidth 1-GHz microwaves over an area equal to that of the cathode. The electromagnetic radiation from the dipole-like electron motions centered on the grid, which follow closely the classical Barkhausen-Kurz description, are reported.

1032 **(LA-UR—83-2710) 240-kA switch with potential application in electromagnetic-launch systems.** Honig, E.M. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-8310164—3). NTIS, PC A02/MF A01. Order Number DE84001174.

From 2. symposium on electromagnetic launch technology; Boston, MA, USA (11 Oct 1983).

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Electromagnetic (EM) launchers have severe switching requirements. Switching demands for railgun systems, for instance, inlcude current conduction from hundreds of kA to a few MA, conduction times of a ms to a few s, standoff voltages as high as a few tens of kV, to rcovery voltages of 1 to 10 kV after conduction, opening and closing duty, and repetitive operation up to about 50 Hz. These demands, particularly for repetitive opening duty, are far beyond the capability of most current switches and switching concepts. This paper will review the performance of rod array triggered vacuum gap (RATVG) switches and discuss their potential for solving switching problems in EM launcher systems. A new mode of operation for the RATVG switch is proposed. Fundamental considerations for the operation of opening switches and their associated transfer circuits are presented. Methods of recovering the railgun's inductive energy to enable efficient repetitive operation are discussed and new circuits with such capability are proposed.

1033 **(LA-UR—83-2716) Mechanical design aspects of the HYVAX railgun.** Fox, W.E.; Cummings, C.E.; Davidson, R.F.; Parker, J.V. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 4p. (CONF-8310164—4). NTIS, PC A02/MF A01. Order Number DE84001168.

From 2. symposium on electromagnetic launch technology; Boston, MA, USA (11 Oct 1983).

The hypervelocity experiment (HYVAX) railgun is designed to produce projectile velocities greater than 15 km/s in a 13-m-long, round bore gun. The HYVAX gun incorporates a modular design enabling it to operate in either a distributed energy-storage mode or a single-stage mode. The gun is composed of seven 0.3-m-long power input modules and nine 1.2-m-long accelerating modules. The gun is designed for a 100-shot life. To accommodate this, the bore may be enlarged from an initial diameter of 10.8 mm to a final diameter of 12.7 mm. This will allow the bore to be refinished several times during the life of the gun. To minimize mechanical and arc damage to the gun between bore refinishing operations, the gun will incorporate a low pressure helium projectile injector. Projectiles will be injected under vacuum at 350 m/s. The gun will be operated at a peak current and voltage of 600 kA and 6 kV respectively. The gun will undergo three phases of testing. The first phase will be the characterization of the gun's performance using a 3.0-m-long section of the gun comprising two power modules and two accelerating modules. This testing will be accomplished using two of the seven capacitor bank modules. The second test phase will use a distributed power configuration and seven capacitor bank modules to demonstrate a velocity of 15 km/s with a 1-g projectile. The predicted performance of the gun for this test phase is illustrated. In the third phase of testing we will use a magnetic flux compression demonstrating a velocity of 25 km/s.

1034 **(LA-UR—83-2717) Design and testing of high-pressure railguns and projectiles.** Peterson, D.R.; Fowler, C.M.; Cummings, C.E.; Kerrisk, J.F.; Parker, J.V.; Marsh, S.P.; Adams, D.F. (Los Alamos National Lab., NM (USA); Wyoming Univ., Laramie (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-8310164—5). NTIS, PC A02/MF A01. Order Number DE84001202.

From 2. symposium on electromagnetic launch technology; Boston, MA, USA (11 Oct 1983).

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The results of high-pressure tests of four railgun designs and four projectile types are presented. All tests were conducted at the Los Alamos explosive magnetic-flux compression facility in Ancho Canyon. The data suggest that the high-strength projectiles have lower resistance to acceleration than the low-strength projectiles, which expand against the bore during acceleration. The railguns were powered by explosive magnetic-flux compression generators. Calculations to predict railgun and power supply performance were performed.

1035 **(N—8322068) Superconducting mixers.** Kollberg, E. (Onsala Space Observatory (Sweden)). Aug 1982. 2p. NTIS, PC A11/MF A01.

A very short review with results on superconducting quasiparticle, Josephson and Super-Schottky mixers is presented.

1036 **(N—8322069) A 185-GHz Josephson point-contact low-noise mixer.** Terhorst, G.; Schaeffer, H.; Poorter, T. (Rijksuniversiteit Groningen (Netherlands)). Aug 1982. 3p. NTIS, PC A11/MF A01.

The performance of a Josephson mixer at 185 GHz is reported. At 185 GHz the best single side band (SSB) mixer temperature was 160 K with a SSB conversion loss of 4.4 dB. The associated total receiver temperature (SSB) is found to be 415 K. The instantaneous bandwidth is 20 GHz.

1037 **(N—8322510) Power factor controllers.** (McGraw-Hill Publications Co., New York (USA)). 1982. 4p. NTIS, PC A02/MF A01.

The power factor controller (PFC) is a solid state electronic device that reduces excessive energy waste in ac induction motors. The significance of the PFC lies in the fact that nearly a billion induction motors are used daily. The PFC is applicable to both single phase and three phase induction motors. Since it is connected to the power lines of the motor and requires no modification to the motor itself, it may be applied to existing motors as well as to new installations.

1038 **(N—8324185) Assembly for onboard SAR data processing. Phase 1: Experimental pretesting at an AD-converter, time expansion and azimut memory. Final Report, April 1981.** Schotter, R.; Hoelzl, H.; Busch, H.; Koyro, J.; Wiegmann, A. (Dornier-Werke G.m.b.H., Oberpfattenhofen (Germany, F.R.)). Dec 1982. 101p. (In German and English). (BMFT-FB-W—82-025). NTIS, PC A06/MF A01.

The functional modules AD-conversion, time expansion, and corner turn memory were investigated. Among the fast 6 bit integrated AD converters appearing on the market the TRW type TDC 1014 J and the SIEMENS SDA 5010 were selected for the measurements. A breadboard of the SDA 5010 was built. The time expansion was designed according to the double buffer principle. The memory was built up with CMOS technology. The power consumption of the time expansion could be limited to 12,2 Watt. The investigations of the corner turn memory clearly showed up the need for a carefully designed control electronics. The memory matrix (9 MByste) was designed with dynamic NMOS circuits. The complete control electronics could be designed with low power Schottky TTL. The power consumption was calculated to be 121 Watts.

1039 **(SAND—83-0957) Transmission lines for pulsed power applications.** Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 76p. NTIS, PC A05/MF A01. Order Number DE84002754.

For pulsed power applications transmission lines serve two generic functions. As the name implies, they are used to transmit pulses with high fidelity and with a fixed propagation delay. This propagation delay and the characteristic impedance completely characterize the transmission line to a reasonable first approximation. With suitable switching, transmission lines are also used to shape submicrosecond pulses. When used for this purpose they will be referred to as pulse forming lines (PFL). The characteristic pulse length produced when a transmission line is used for pulse shaping is twice its propagation delay which for transmission lines normally used in pulsed power applications ranges from 3 to 30 nanoseconds per meter of line length.

1040 **(SAND—83-1657C) $In_{0.2}Ga_{0.8}As/GaAs$, modulation-doped, strained-layer superlattice field-effect transistor.** Zipperian, T.E.; Dawson, L.R.; Osbourn, G.C.; Fritz, I.J. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 5p. (CONF-831243—1). NTIS, PC A02/MF A01. Order Number DE84000136.

From International electron device meeting; Washington, DC, USA (5 Dec 1983).

For the first time, field-effect transistor action has been demonstrated in InGaAs/GaAs strained-layer superlattice (SLS) material. The samples, prepared by MBE, utilized 17 periods (repeat distance, 300A) of alternating, modulation-doped, $In_{0.2}Ga_{0.8}As$ and GaAs layers to form the channel of the device. Gate control was realized by use of an Al Schottky diode on the top and a p-n junction diode, formed between the superlattice and a p-type $In_{0.1}Ga_{0.9}As$ buffer layer, on the bottom. At room temperature a representative transistor with a 2.5 μm gate length displayed a characteristic drain saturation current, I/sub DSS/, of 64 mA (V/sub DS/ = 4V, V/sub GS/ = OV), a double-gate pinchoff voltage, Vp, of 3.1V(V/sub DS/ = 4V, I/sub D/ = 5% of I/sub DSS/) and a maximum, double-gate, normalized, extrinsic transconductance, g/sub mo/, of 84mS/mm (V/sub DS/ = 4V). At 77K, I/sub DSS/ increased to 98mA, Vp remained approximately constant at 3.2V, and g/sub mo/ increased to 140mS/mm.

1041 **Future microelectronic devices: materials aspects and interfacial phenomena.** Murr, L.E. (New Mexico Institute of Mining and Technology). *Microelectronics Journal;* **10**: No. 4, 12-19(1979). Contract AC04-79AL10887.

The inevitable, continued reduction in dimensional features of microelectronic devices has already caused a shift to higher-resolution processing techniques and will require even more sophisticated circuit viewing schemes involving the transmission electron microscope. Decreasing dimensions of all components will result in new equivalent circuit concepts because interfaces normally swamped in LSI devices, will become viable, controllable features of fabrication, and may in fact be the device limiting dimensional feature. Furthermore, the ability to tailor lattice parameters and stoichiometries over small dimensions (<0.01μm) will, coupled with phenomena at the submicron level, pose some of the most exciting materials applications of the century.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 191, 311, 702, 968

1042 **(DOE/ET/10393—1459) Research instrumentation system description, installation and commissioning.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe (UK)). 21 Jan 1982. Contract AI01-76ET10393. 143p. NTIS, PC A07/MF A01. Order Number DE83015513.

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This report includes all aspects of Research Instrumentation development, design, installation, commissioning and operation, taking account of modifications made or in hand at March, 1982. The overall project objectives and the detailed experimental objectives of the Research Instrumentation systems are described. Development of the Research Instrumentation from the initial proposals in December, 1977 to commissioning and operation during 1981 is detailed in chronological order. The key dates and activities relating to the provision of Research Instrumentation facilities are listed. A general description of the main facility is given, followed by a detailed description of the design of each Research Instrumentation system including the control system and utility services. The design criteria and design data are tabulated in order to illustrate the reasons for certain aspects of the detailed design. The method of operation of each system is also described. Work carried out during the installation and commissioning periods from October, 1980 to December, 1981 is described and the allocation of labour and the difficulties encountered during this period are highlighted. An account is given of the main commissioning activities carried out. The operation and performance of each Research Instrumentation system is reviewed. The design and operating data for each system are tabulated and compared as an indication of how the installed system met the design requirements. With the exception of the traversing dust sampling systems, where commissioning was not completed and the alkali sampling system which was not installed until December, 1981, all the systems performed satisfactorily. The ability of each system to meet the particular experimental objectives is also appraised. Problems which occurred and the modifications required as a result of commissioning and operating experience are itemised.

1043 **(DOE/ET/10393—1460) Test Series 2.1 detailed test plan.** (NCB (IEA Grimethorpe) Ltd., Barnsley, South Yorkshire (UK)). 10 Mar 1983. Contract AI01-76ET10393. 65p. NTIS, PC A04/MF A01. Order Number DE83015493.

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Test Series 2.1 is the first of the sub-series of Test Series 2, the second stage of the combustion research programme to be carried out at the Grimethorpe Experimental Pressurised Fluidised Bed Combustion Facility. Test Series 1 formed the first stage and was completed in December 1981. Test Series 2.1 is to consist of 350 data gathering hours to be obtained from 700 coal burning hours. The report provides a brief description of the Facility and modifications carried out since Test Series 1 and sets out the test plan and objectives for Test Series 2.1. Also discussed are the part-load conditions and frequency response tests that are to be included within Test Series 2.1.

1044 **(N—8322419) The effects of heat flux on the corrosion of high pressure boilers.** Tomlinson, L.; Pritchard, A.M. (UKAEA Atomic Energy Research Establishment, Harwell). Dec 1982. 30p. (AERE-R—10765). Avail: Issuing Activity.

The presence of a heat flux increases the metal surface temperature, and, where boiling occurs, can lead to the concentration of solutes present in the feedwater of high pressure boilers. In the absence of boiling, the increase in corrosion rate due to the presence of a heat flux should be small and related to the known activation energy of the process. In the nucleate boiling region, the increased surface temperature and mass transport to the wall can lead to the production of thicker coherent oxide films in the presence of soluble corrosion products with reverse solubility curves. Where defects are present in the surface of the boiler tube, or porous structures develop, enhanced boiling can occur, and corrosive salt concentrations many orders of magnitude greater than in the feedwater can be developed within them. Similar concentrations of salts may form where the tube surface becomes dry, at low steam qualities due to the effects of tube geometry on flow, or where the annular film dries out in a once through boiler. Impingement of droplets on the boiler tube wall beyond the dry out zone can also increase corrosion. Salts dissolved in superheated steam interact with the boiler wall and may become irreversibly incorporated in the growing oxide. The effects of different water chemistry regimes on these processes are outlined, and the value of radiotracers in studying salt concentration and metal corrosion under heat flux at high temperatures and pressures is shown.

1045 **Saving fuel with furnaces.** Monroe, E.S. Jr. Cambridge, MA; The MIT Press (1982). 46p.

Fuel utilization in furnaces can be improved through the proper design, selection, and operation of boiler-furnace combinations. Practical techniques are presented. Tables, figures, and unit tests for the reader to take are included.

1046 **Measuring and improving the efficiency of boilers.** Dyer, D.; Maples, G.; Maxwell, J.C. Jr. Cambridge, MA; The MIT Press (1982). 111p.

Boilers offer great opportunities for fuel saving in that boilers are used in nearly every manufacturing plant. Their operating characteristics, control, testing, maintenance, and troubleshooting, feedwater treatment, and the recovery of waste heat are discussed. Definitions and tables are included as well as self-tests.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 1203

1047 **(RFP-Trans—410) Use of coke to render high nitrogen oxides concentrations harmless.** Ito, H.; Tominaga, S.; Shimizu, K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Kawasaki Heavy Industries Ltd., Kobe (Japan)). Oct 1983. Contract AC04-76DP03533. Translation of Japanese Kokai Patent Publication No. Sho 53-56166, 1978. 9p. NTIS, PC A02/MF A01. Order Number DE84001072.

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A process for using coke to render high nitrogen oxides concentrations harmless by introducing gas with a high nitrogen oxides concentration into a coke oven is described. The process is characterized by the introduction of steam and air in a suitable volume ratio into the coke oven in order to prevent the formation of clinker scales due to coke ash and to control the reaction temperature at will within the range of 700 to 1400°C. High concentration of nitrogen oxides in feeder stream is thereby rendered harmless.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 990, 992, 1013, 1082

1048 **(BNL—32768) Design and fabrication of the BNL radio frequency quadrupole.** McKenzie-Wilson, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 3p. (CONF-830311—190). NTIS, PC A02/MF A01. Order Number DE84001456.

From Particle accelerator conference; Santa Fe, NM, USA (21 Mar 1983).

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The Brookhaven National Laboratory polarized H^- injection program for the AGS will utilize a Radio Frequency Quadrupole for acceleration between the polarized source and the Alvarez Linac. Although operation will commence with a few μ amperes of H^- current, it is anticipated that future polarized H^- sources will have a considerably improved output. The RFQ will operate at 201.25 MHz and will be capable of handling a beam current of 0.02 amperes with a duty cycle of 0.25%. The resulting low average power has allowed novel solutions to the problems of vane alignment, rf current contacts, and removal of heat from the vanes. The cavity design philosophy will be discussed together with the thermodynamics of heat removal from the vane. Details of the fabrication will be presented with a status report.

1049 **(BNL—33698) Conceptual design of a 300-GeV accelerator based on the inverse free-electron laser mechanism.** Pellegrini, C.; Sprangle, P.; Zakowicz, W. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 5p. (CONF-830822—36). NTIS, PC A02/MF A01. Order Number DE84001471.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

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We describe an Inverse Free Electron Laser Accelerator and how it can be used to accelerate electrons to energies of several hundred GeV, with an average acceleration rate of 150 MeV/m. We discuss the system scaling laws for several undulators designs and the methods for laser beam transport over the required distance of a few kilometers.

1050 **(CAPE—2895) SLAC 24 megawatt pulse klystron permanent magnet outline (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 12 Jan 1981. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The listed drawings provide the main outline dimensions and form of the permanent magnet used with the SLAC 24 Megawatt Pulse Klystron. This klystron is slowly being replaced by the XK-5 40 MW (nominal) klystron.

1051 **(CAPE—2905) SLAC klystron pulse transformer tank with oil expansion tank (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 10 Dec 1979. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the auxiliary drawing list provide the data and specifications for constructing the SLAC klystron pulse transformer tank assembly. The tank is used to step up the high voltage pulse produced by the modulator. It is mounted on the base of the klystron and forms an integral unit for mounting and transporting. Insulation is provided by transformer oil and expansion due to heat is accommodated by the outboard expansion tank. The klystron-tank assembly provides rf power to the accelerator pipe.

1052 **(FERMILAB/TM—1211) Why superferric magnets for a desertron.** Huson, F.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). 27 Mar 1983. Contract AC02-76CH03000. 17p. NTIS, PC A02/MF A01. Order Number DE84002528.

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It has been proposed by R.R. Wilson and L. Lederman that it may be advantageous and cheaper to construct a large accelerator (> 10 TeV) with superferric magnets (~ 2.5 Tesla). We take as a premise that a sufficiently large piece of land is available for the accelerator (see paper on Site and Tunnel), that is, one is not limited by the radius of the tunnel. The word superferric has been interpreted to mean a super conducting magnet where the coils are used principally to drive the field in the steel. We also add the constraint of simplicity and keep the coil shaped in a rectangle with no more than a few turns.

1053 **(KFTI—81-52) Physical experiment technique.** (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1981. 76p. (In Russian). (CONF-8106218—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780033.

From 7. all-union seminar on linear accelerators; Kharkov, Ukrainian SSR (2 Jun 1981).

Abstracts of individual items from the seminar were prepared separately for the data base. (GHT)

1054 **(LA—9835-PR) White Horse Program review, FY 82.** Dogliani, H.O.; Farrell, J.A. (comps.). (Los Alamos National Lab., NM (USA)). Sep 1983. Contract W-7405-ENG-36. 141p. NTIS, PC A07/MF A01. Order Number DE84002290.

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A review of major achievements in the White Horse Program is provided. Most efforts in FY 82 involved completion of the 2-MeV accelerator test stand culminating in installation of the RFQ, on-line in September 1982. Numerous experiments were conducted, resulting in a significant understanding of beam dynamics and rf structures.

1055 **(SLAC-PUB—3149) Plasma beat-wave accelerator.** Noble, R.J. (Stanford Linear Accelerator Center, CA (USA)). Jun 1983. Contract AC03-76SF00515. 4p. (CONF-830822—33). NTIS, PC A02/MF A01. Order Number DE84001601.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

We perform an analytic study of some quantities relevant to the plasma beat-wave accelerator (PBWA) concept. We obtain analytic expressions for the plasma frequency, longitudinal electron velocity, plasma density and longitudinal plasma electric field of a nonlinear longitudinal electron plasma oscillation with amplitude less than the wave-breaking limit and phase velocity approaching the speed of light. We also estimate the luminosity of a single-pass e^+e^- linear PBWA collider assuming the energy and collision beamstrahlung are fixed parameters.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 1078, 1104

1056 **(CAPE—2908) SLAC LASS secondary X-Y beam steering (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 10 Jan 1980. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The logic diagram provides the basic layout and ideas embodied in the special secondary beam X-Y steering position readout for the Large Aperture Solenoidal Spectrometer as used at SLAC. The particles in the secondary SLAC beam (primary beam for LASS) are obtained by bombarding a metal target with the SLAC electron beam. This device was a continuous reading device and was operational even when the computer was down. The steering system augmented the computer system and provided an additional check on the state of the beam.

1057 **(FERMILAB/TM—1210) Magnetic-field considerations in superferric dipole.** Snowdon, S.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 21 Mar 1983. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01. Order Number DE84002573.

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Iron dominated magnets are characterized in the limit of infinite permeability by a pole shape that is a magnetic equipotential. Deviations from this ideal because of finite permeability are associated with differences in path length, local saturation, flux concentration in slotted pole if crenellation is used, and sub surface voids. For moderate field levels the variation in flux path length throughout the iron lowers the magnetic potential on the iron surface more for the longer paths. As the excitation increases the permeability is lowered in regions of high flux density. Crenellation in this region offers some degree of control over the permeability by concentrating the flux. To a lesser degree sub surface voids can be used to control the reluctance of a flux path. The net result suggests that the shape of the effective air gap can be adjusted to be a magnetic equipotential sensibly equivalent to the ideal pole shape for infinite permeability.

1058 **(FERMILAB/TM—1215) Power tests of the Fermilab Lithium Lens for antiproton collection.** Biallas, G.; Dugan, G.; Hangst, J.; Hanson, R.; Hojvat, C.; Lange, F.; Lennox, A.J.; McCarthy, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1983. Contract AC02-76CH03000. 4p. NTIS, PC A02/MF A01. Order Number DE84002563.

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A prototpye Lithium Lens to be used for the collection of antiprotons in the Fermilab Tevatron I project has been constructed. Some of the fabrication details, the procedure for lithium filling and the results of the initial operation are discussed.

1059 **(JAERI—1278) Self-focusing of a pulsed electron beam in gases and their ionization. A novel approach to discharge chemistry.** Hotta, H.; Arai, Hidehiko; T., R.; Sunaga, H. (Japan Atomic Energy Research Inst., Tokyo). Jun 1982. 81p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE83703702.

A relativistic high-intensity pulsed electron beam generated from a Febetron 706 was strongly self-focused in two pressure regions, i.e., below and above 5 Torr. The dependence of the electron energy spectrum on pressure and path length in He was at first studied by measuring depth-dose distributions in an aluminum-blue cellophane stack. Then, maximum doses of the depth-dose curves in the dosimeter placed on the beam axis at 10.4 cm from the cell window were measured as functions of pressure in He, Ne, Ar, Kr, Xe, H_2, D_2, N_2, O_2, N_2O, CO_2, SF_6, CH_4, C_2H_2, C_2H_4, C_2H_6, C_3H_8, CH_3F, $CHClF_2$, CCl_2F_2, He + X, Ar + X, and O_2 + X (X: additive gas). The strong self-focusing at pressure lower than 5 Torr is attributed to space-charge neutralization by positive ions due to escaping of secondary electrons. Therefore, relative total ionization cross sections for beam electrons could be obtained in this region. When the space-charge neutralization time becomes shorter than a rise time of the pulsed beam, secondary electrons are accelerated by a backward electric field E sub(z) induced by the pulsed beam so that the self-focusing declines abruptly due to electron avalanching. The beam is self-focused again gradually with further increasing pressure because of suppression of this avalanching. The avalanching was analyzed self-consistently for He, Ar, H_2, N_2, and CH_4 by a computer simulation in the pressure region between 5 and 300 Torr. The present computational results indicate that the larger cose is given by the longer mean ionization time t sub(i) which depends on E sub(z)/p. The value of t sub(i) increases with increasing pressure in the pressure region of gradually-increasing self-focusing.

1060 **(SLAC-PUB—3170) 1.2-GeV damping-ring complex for the Stanford Linear Collider.** Fischer, G.E.; Davies-White, W.; Fieguth, T.; Wiedemann, H. (Stanford Linear Accelerator Center, CA (USA)). Jul 1983. Contract AC03-76SF00515. 4p. (CONF-830822—34). NTIS, PC A02/MF A01. Order Number DE84001606.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

The choice of parameters, the design, a 2-1/2 year consruction program and the early operation of a high field, high tune research and development damping ring complex for one of the two linear collider beams are described.

1061 **(SLAC-PUB—3179) Beam-beam instability.** Chao, A.W. (Stanford Linear Accelerator Center, CA (USA)). Aug 1983. Contract AC03-76SF00515. 44p. NTIS, PC A03/MF A01. Order Number DE84002753.

The subject of beam-beam instability has been studied since the invention of the colliding beam storage rings. Today, with several colliding beam storage rings in operation, it is not yet fully understood and remains an outstanding problem for the storage ring designers. No doubt that good progress has been made over the years, but what we have at present is still rather primitive. It is perhaps possible to divide the beam-beam subject into two areas: one on luminosity optimization and another on the dynamics of the beam-beam interaction. The former area concerns mostly the design and operational features of a colliding beam storage ring, while the later concentrates on the experimental and theoretical aspects of the beam-beam interaction. Although both areas are of interest, our emphasis is on the second area only. In particular, we are most interested in the various possible mechanisms that cause the beam-beam instability.

1062 **(SLAC-PUB—3183) Undulator induced resonances.** Harris, J.; Morton, P.; Spencer, J.; Winick, H. (Stanford Linear Accelerator Center, CA (USA)). Aug 1983. Contract AC03-76SF00515. 4p. (CONF-830822—38). NTIS, PC A02/MF A01. Order Number DE84001925.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

Undulators appear to be nearly ideal radiation sources for use in storage rings because of their high brightness and small perturbation on stored beam characteristics. We consider the effects of higher-order magnetic field errors and show how they increase beam size and may lead to unstable growth of betatron oscillations. We have observed such effects in SPEAR at betatron tunes satisfying the equations: 3nu/sub x/ + nu/sub y/ = 21 and nu/sub x/ + 3nu/sub y/ = 21. The widths of these resonances were measured to be $\Gamma = 0.008 +- 0.004$. They are clearly visible on the synchrotron light monitors with a very dynamic and characteristic beam blow-up pattern (reminiscent of a Miller beer label). A model is de-

veloped which predicts the locations of resonances, their widths and the projected shapes observed on the light monitors. By inducing such high-order coupling resonances one could study such things as the beam distribution in electron rings or possibly turbulent motion in proton rings.

1063 **(SLAC-PUB—3186) Nonintercepting emittance monitor.** Miller, R.H.; Clendenin, J.E.; James, M.B.; Sheppard, J.C. (Stanford Linear Accelerator Center, CA (USA)). Aug 1983. Contract AC03-76SF00515. 4p. (CONF-830822—39). NTIS, PC A02/MF A01. Order Number DE84001924.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

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A nonintercepting emittance monitor is a helpful device for measuring and improving particle beams in accelerators and storage rings as it allows continuous monitoring of the beam's distribution in phase space, and perhaps closed loop computer control of the distributions. Stripline position monitors are being investigated for use as nonintercepting emittance monitors for a beam focused by a FODO array in the first 100 meters of our linear accelerator. The technique described here uses the signal from the four stripline probes of a single position monitor to measure the quadrupole mode of the wall current in the beam pipe. This current is a function of the quadrupole moment of the beam, σ^2/sub x/ - σ^2/sub y/. In general, six independent measurements of the quadrupole moment are necessary to determine the beam emittance. This technique is dependent on the characteristically large variations of σ^2/sub x/ - σ^2/sub y/ in a FODO array. It will not work in a focusing system where the beam is round at each focusing element.

1064 **(UCRL—89881) Beam dynamics in the Advanced Test Accelerator (ATA).** Caporaso, G.J.; Barletta, W.A.; Birx, D.L.; Briggs, R.J.; Chong, Y.P.; Cole, A.G.; Fessenden, T.J.; Hester, R.E.; Lauer, E.J.; Neil, V.K. (Lawrence Livermore National Lab., CA (USA)). 28 Sep 1983. Contract W-7405-ENG-48. 7p. (CONF-830911—33). NTIS, PC A02/MF A01. Order Number DE84001421.

From 5. international conference on high power particle beams; San Francisco, CA, USA (12 Sep 1983).

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We will review the performance of the Advanced Test Accelerator, a 50 MeV, 10 KA induction linac. The discussion will cover the operation of the plasma cathode electron source, beam transport throughout the accelerator, and transverse instabilities. Particular emphasis will be placed on the beam breakup instability and on the methods used to minimize it. These include a program of design changes that lead to an order of magnitude reduction in the Q's of the accelerator cavity modes and optimization of the transport tune.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 780, 1056, 1058

1065 **(CAPE—2892) SLAC K-Meson Survey Beam Beryllium Target (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 16 Jul 1968. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the Drawing List provide the data and specifications for constructing the K Meson Survey Beam Beryllium Target as used in the SLAC Beam switchyard. This target is used to generate K mesons by striking the target with electrons. The target is removable, either manually or remotely, depending on the design of the installation.

1066 **(CAPE—2896) SLAC pulse-pair generator (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 16 Jan 1980. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the Drawing List provide the data and specifications for the construction of the SLAC Pulse Pair Generator. This device is used to generate a train of pulse pairs with a precise settable pulse pair spacing for the checking or calibrating equipment such as drift chambers used in experiments on SPEAR, PEP and the Stanford Linear Accelerator.

1067 **(CAPE—2900) SLAC MK III detector magnet door lifting assembly (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 13 Nov 1979. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The subassembly drawings listed provide the information for constructing a lifting mechanism and stand for the doors on the MK III Detector. These doors are large and heavy parts of the MK III Detector. They are used to provide shielding and magnetic return for the detector. This system is used on the SLAC PEP Storage Ring.

1068 **(CAPE—2902) SLAC accelerator support - girders and jacks (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 22 Jan 1981. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the auxiliary drawing list provide the construction details for several of the typical support girders as used on the SLAC Two-Mile Linear Accelerator. These assemblies are used to support the accelerator disk-loaded waveguides that provide the vacuum chamber for the electrons and also the means of transferring energy from the rf power to the beam of electrons or positrons. The jacks are used to provide alignment adjustment and stability of the 40-foot support girders.

1069 **(CAPE—2903) SLAC SPEAR vertical beam scraper-kicker magnet straight section - Section 4 and 5, and 14 and 15 (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 8 Jan 1974. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the auxiliary drawing list provide the information for constructing a vertical beam scraper as used on the SLAC SPEAR storage ring near the kicker magnet straight section. This assembly provides a means of removing unwanted beam particles from the beam in order to maintain a certain size beam and also to protect the kicker magnet and other devices from stray particles and radiation. This device is used in Section 4 and 5 and 14 and 15 in the SLAC SPEAR storage ring.

1070 **(CAPE—2904) SLAC PEP time projection chamber - two gamma experiment beam line vacuum assembly (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 18 Aug 1983. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings on the auxiliary drawing list provide the information for constructing the vacuum beam line for the experiment using the Time Projection Chamber and the 2-Gamma setup. This assembly is located in Interaction Region 2 of the SLAC PEP storage ring. Some, but not all, of the supports are included. Other hardware generally is not included in this set of drawings. The vacuum system is nominally defined by drawing SA 205-027-01-R1 TPC/2G Vacuum System - Overall Assembly.

1071 **(CAPE—2906) SLAC beam monitor scraper - kicker magnet straight section (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 17 Jul 1973. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

7 35-mm aperture cards.

The drawings listed on the auxiliary drawing list provide the data and specifications for constructing the left- and right-hand beam position monitor scrapers on the Kicker Magnet Straight Section. This assembly is used to provide protection for the beam posi-

tion monitor elements from synchrotron radiation and beam particles in the SLAC SPEAR Storage Ring.

1072 **(FERMILAB/TM—1212) Tunnel construction for a desertron.** Hinterberger, H.; Huson, F.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). 27 Mar 1983. Contract AC02-76CH03000. 17p. NTIS, PC A02/MF A01. Order Number DE84002561.

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The tunnel in this model of construction is 3-1/2 feet wide by 5 feet high. It is assumed that the tunnel contains a rail system and guidance system for: (1) An enclosed car used for transport of 2 people and some tools. (2) A magnet mover. This robot could pick up a magnet and transport it at about 10 miles per hour. (3) An alignment robot. The alignment robot would intercept E.M. waves (microwaves, lasers) to determine its position in the tunnel. Then workers could come along inside the tunnel hoop and nail it together and to the floor. The trench would then be back-filled with a 1 foot berm on top. A rail system would be installed and a support stand for the magnet.

1073 **(FERMILAB/TM—1213) 20-TeV colliding-beam facilities.** Huson, F.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). 15 Sep 1983. Contract AC02-76CH03000. 11p. NTIS, PC A02/MF A01. Order Number DE84002562.

In March, a workshop was held at Cornell University on the accelerator. The conclusion of this workshop was that a 20 TeV on 20 TeV proton-proton collider is technically feasable, that construction could begin after 2.5 to 4 years of research and development, and the cost would be 1.3 to 2 billion dollars. To put this machine into perspective one must consider the existing facilities listed in table I. There are about 23 high energy physics laboratories in the world that are being operated or constructed. Most of these labs have an effective energy of less than 100 GeV and study principally the known quarks and leptons. The only accelerator operating at an effective energy greater than 100 GeV is the CERN proton-anti-proton system. As has been presented at this conference in other papers their success has been great in a very short time, the discovery of the vector bosons W and Z. The only machine approved that will have an effective energy greater than 1000 GeV is the Russian accelerator UNK. The effective energy of a 20 TeV on 20 TeV proton-proton collider would be about 15 TeV.

1074 **(FERMILAB/TM—1214) Potential 20-TeV site in Illinois - Dekalb.** Huson, F.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). 21 Sep 1983. Contract AC02-76CH03000. 6p. NTIS, PC A02/MF A01. Order Number DE84002564.

The Batavia, Illinois location has all the necessary requirements for a major high energy physics laboratory, i.e., near a major airport and road system, many good universities within driving distance, a large pool of technical people in the area, all types of industry nearby, and centrally located. Even with these characteristics usually associated with urban areas, there also exists nearby open land where perhaps a 20 TeV collider could be located. Preliminary studies are being made of potential sites in Illinois for a 20 TeV collider. The largest ring that has been looked at has a 25 kilometer radius (30 mile diameter). This was picked since the lowest magnetic field (3 Tesla) would give 20 TeV and smaller rings should be easier to accommodate. The motivation for the siting of this ring was to find a location near Fermilab so that the infrastructure could be used including the Energy Doubler as an injector. One ring considered went through Fermilab and out toward the west. The obvious advantage of this ring would be to have the experimental areas on the Fermilab site. The difficulty with this ring is that it must be quite deep to pass under the Fox river twice. At this time we have only looked in some detail at a site west of the Fox river with an injection line from Fermilab that passes under the river. We call this ring the Dekalb site.

1075 **(FERMILAB/TM—1218) Tunneling beyond the Fermilab site.** Baker, S.; Elwyn, A.; Lach, J.; Read, A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 Jul 1983. Contract AC02-76CH03000. 21p. NTIS, PC A02/MF A01. Order Number DE84002565.

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An accelerator that crosses the Fermilab site boundary must have a minimum effect on the surrounding environment and the people residing in the area. Unobstructed public access should be allowed above the ring except in relatively few areas such as the injection, dump, and experimental regions. The accelerator should be a benign and unobtrusive neighbor not only when it is completed but also in the construction period. For these reasons underground tunneling for all or most of the ring seems attractive. In this note we look into some questions raised by tunneling beyond the Fermilab site. Most of our discussion is of general applicability. However, we will use as examples two specific ring configurations. The examples have not been optimized from the point of view of physics output or accelerator technology but are just specific examples which allow us to study questions of tunneling. One is a ring of 5 km radius (5 TeV) tangent to the Tevatron and entirely east of the Fox River and fed by a beam from the Tevatron which crosses under the river. We assume that each of these machines will have 100 beam fills per year and we scale the maximum intensities with the accelerator radii. Thus we assume that there will be 1.0 E14 protons in each beam of the 20 TeV machine and 2.5 E13 for the 5 TeV machine.

1076 **(FERMILAB/TM—1219) Magnetic-field design of the accumulator multipole magnet.** Oleksiuk, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). 25 Oct 1983. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01. Order Number DE84002566.

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A multiple magnet using the FFAG graded coil technique has been designed with the aid of the two dimensional magnet modelling code Poisson. Rapid design interaction in problem formulation has been achieved with a new finite element mesh generator in which mesh densities can be manipulated to overcome difficulties in mesh topologies when spanning the grid over the problem domain.

1077 **(GKSS—82/E/52) Calculation and optimization for the RIG 10 high intensity ion source.** Haeuser, J.; Eppel, D.; Tanzer, F. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 8p. (CONF-820618—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751320.

From International conference on plasma physics; Goeteborg, Sweden (7 Jun 1982).

The paper discusses the solution of the ion optics for high current beams extracted from a plasma and the application to the RIG 10 ion source used for the ASDEX experiment.

1078 **(LA-UR—83-2669) Simulation studies on a novel betatron injection scheme.** Peter, W.; Faehl, R.J.; Mako, F. (Los Alamos National Lab., NM (USA); Naval Research Lab., Washington, DC (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-830911—32). NTIS, PC A02/MF A01. Order Number DE84001337.

From 5. international conference on high power particle beams; San Francisco, CA, USA (12 Sep 1983).

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The feasibility of external transport into a modified betatron by the propagation of a relativistic electron beam into a z-pinch channel is discussed. Results from particle-in-cell simulations do not indicate any deleterious instabilities. Though the plasma collision frequency is shown to be just large enough to suppress the beam-plasma instability, a discharge current tapering scheme for decreasing the beam perpendicular velocity will also be a principal stabilizing mechanism. A new high-frequency microwave source based on this study is also detailed.

1079 **(LA-UR—83-2693) Design features and performance of the LAMPF high-intensity beam area.** Agnew, L.; Grisham, D.; Macek, R.J.; Sommer, W.F.; Werbeck, R.D. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 7p. (CONF-8309156—7). NTIS, PC A02/MF A01. Order Number DE84001318.

From 7. meeting of the international collaboration on advanced neutron sources; Ontario, Canada (12 Sep 1983).

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LAMPF is a multi-purpose high-intensity meson factory capable of producing a 1 mA beam of 800-MeV protons. The three target cells and the beam stop facilities in the high intensity area have many special design features that are required for operation in the presence of high heat loads and intense radiation fields where accessibility is extremely limited. Reliable targets, beam windows, beam stops, beam transport and diagnostic components, vacuum enclosures, and auxiliary systems have been developed. Sophisticated remote-handling systems are employed for maintenance. Complex protection systems have been developed to guard against damage caused by errant beam. Beam availability approaching 90% has been achieved at currents of 600 to 700 μA. A new facility for direct proton and neutron radiation effects studies will be installed in 1985. The new facility will provide an integrated spallation neutron flux of up to 5 x 10^{17} $m^{-2}s^{-1}$ and will anable proton irradiation studies in the primary beam.

1080 **(LA-UR—83-2736) Radiation-resistant beamline components at LAMPF.** Macek, R.J.; Grisham, D.L.; Lambert, J.e.; Werbeck, R. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 7p. (CONF-8309156—6). NTIS, PC A02/MF A01. Order Number DE84001308.

From 7. meeting of the international collaboration on advanced neutron sources; Ontario, Canada (12 Sep 1983).

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A variety of highly radiation-resistant beamline components have been successfully developed at LAMPF primarily for use in the target cells and beam stop area of the intense proton beamline. Design features and operating experience are reviewed for magnets, instrumentation, targets, vacuum seals, vacuum windows, collimators, and beam stops.

1081 **(LA-UR—83-3061) He-jet system to study short-lived fission-product nuclei at LAMPF.** Talbert, W.L. Jr.; Bunker, M.E.; Starner, J.W. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 10p. (CONF-8310104—1). NTIS, PC A02/MF A01. Order Number DE84001734.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

Experiments have been performed at LAMPF which demonstrate the feasibility of utilizing a He-jet system to transport fission products to an on-line mass separator from a target chamber mounted in the 800-MeV, >600μA main proton beam. Activities of essentially all elements produced are transported with about 60% absolute efficiency, both for fission reactions and spallation reactions. Transport times are short enough to allow study of activities with half-lives as short as 300 ms. Technical features and scientific possibilities of the system are presented.

1082 **(LBL—16125) Accelerator and Fusion Research Division annual report, October 1981-September 1982. Fiscal year 1982.** Johnson, R.K.; Bouret, C. (eds.). (Lawrence Berkeley Lab., CA (USA)). May 1983. Contract AC03-76SF00098. 96p. NTIS, PC A05/MF A01. Order Number DE84001624.

This report covers the activities of LBL's Accelerator and Fusion Research Division (AFRD) during 1982. In nuclear physics, the Uranium Beams Improvement Project was concluded early in the year, and experimentation to exploit the new capabilities began in earnest. Technical improvement of the Bevalac during the year centered on a heavy-ion radiofrequency quadrupole (RFQ) as part of the local injector upgrade, and we collaborated in studies of high-energy heavy-ion collision facilities. The Division continued its collaboration with Fermilab to design a beam-cooling system for the Tevatron I proton-antiprotron collider and to engineer the needed cooling components for the antiproton. The high-field magnet program set yet another record for field strength in an accelerator-type dipole magnet (9.2 T at 1.8 K). The Division developed the design for the Advanced Light Source (ALS), a 1.3-GeV electron storage ring designed explicitly (with low beam emittance and 12 long straight sections) to generate high-brilliance synchrotron light from insertion devices. The Division's Magnetic Fusion Energy group continued to support major experiments at the Princeton Plasma Physics Laboratory, the Lawrence Livermore National Laboratory (LLNL), and General Atomic Co. by developing positive-ion-based neutral-beam injectors. Progress was made toward converting our major source-test facility into a long-pulse national facility, the Neutral Beam Engineering Test Facility, which was completed on schedule and within budget in 1983. Heavy Ion Fusion research focused on planning, theoretical studies, and beam-transport experiments leading toward a High Temperature Experiment - a major test of this promising backup approach to fusion energy.

1083 **(LBL—16539) Preliminary study of magnet design for an SSC.** Taylor, C.E.; Meuser, R.B. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 8p. (CONF-830822—37). NTIS, PC A02/MF A01. Order Number DE84001814.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

The overriding design consideration for the SSC magnets is that cost of the facility be minimized; at 8 T, approximately 40 km of bending magnets is required for each ring of a 20 TeV collider. We present some results of a parametric study of two-in-one, iron-core magnets for an SSC. These results are necessarily preliminary in nature, and are intended only to show some of the trade-offs for a wide range of the variables. We show also some results for a reference design that produces 6.5 T in the aperture at 4.4 K for a coil inside diameter of 40 mm. It is not to be inferred that we have established this to be an optimum in any sense.

1084 **(SLAC-PUB—3169) 650 mm long liquid hydrogen target for use in a high intensity electron beam.** Mark, J.W. (Stanford Linear Accelerator Center, CA (USA)). Jul 1983. Contract AC03-76SF00515. 8p. (CONF-830841—27). NTIS, PC A02/MF A01. Order Number DE84002552.

From Cryogenic engineering conference and international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

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This paper describes a 650 mm long liquid hydrogen target constructed for use in the high intensity electron beam at the Stanford Linear Accelerator Center. The main design problem was to construct a target that would permit the heat deposited by the electron beam to be removed rapidly without boiling the hydrogen so as to maintain constant target density for optimum data taking. Design requirements, construction details and operating experience are discussed.

1085 **(SLAC-PUB—3204) Intelligent mirror monitor and controller for synchrotron radiation beam lines.** Xu, X.L.; Yang, J. (Stanford Linear Accelerator Center, CA (USA); Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.). 1983. Contract AC03-76SF00515. 6p. (CONF-830910—5). NTIS, PC A02/MF A01. Order Number DE84001928.

From 3. national conference on synchrotron radiation instrumentation; Upton, NY, USA (12 Sep 1983).

A microprocessor-based, stand-alone mirror monitor and control system has been developed for synchrotron radiation beam lines. The operational requirements for mirror position and tilt angle, including the parameters for controlling the number of steps, direction, speed and acceleration of the driving motors, may be programmed into EPROMS. The instruction sequence to carry out critical motions will be stored in a program buffer. A manual control knob is also provided to fine tune the mirror position if desired. A synchronization scheme for the height and tilt motions maintains a fixed mirror angle during insertion. Absolute height and tilt angle are displayed. Electronic (or programmable) tilt angle limits are provided to protect against damage from misalignment of high power beams such as focussed wiggler beams. A description of mirror drives with a schematic diagram is presented. Although the controller is made for mirror movers, it can be used in other applications where multiple stepping motors perform complex synchronized motions.

4304 Storage Rings

REFER ALSO TO CITATION(S) 998, 999, 1061

1086 **(BNL—33742) Evaluation of CBA first string full cell vacuum system.** Foerster, C.L.; Briggs, J.; Christianson, C.; Stattel, P. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 26p. (CONF-831171—11). NTIS, PC A03/MF A01. Order Number DE84002576.

From American Vacuum Society meeting; Boston, MA, USA (1 Nov 1983).

The CBA (Colliding Beam Accelerator, formerly known as ISABELLE) Full Cell Magnet System consisting of six superconducting dipole magnets and two superconducting quadrupole magnets requires two separate vacuum systems. One, known as beam vacuum operates below 3 x 10^{-11} Torr and the other, known as insulating vacuum, operates at less than 10^{-7} Torr to isolate cryo circuits from atmosphere and from the uhv beam tubes. The uhv bore tube is isolated from the 4.0°K magnet by thirty-six (36) layers of superinsulation and insulating vacuum. Heat load measurements on the bore tube have been completed and found to agree with data obtained in smaller controlled experiments. Measurements of helium, accumulated on cryogenic pumped charcoal panels over many weeks, have verified sensitive helium mass spectrometer leak detection methods for vacuum integrity, providing sound design of the welded complex. The Full Cell was assembled and operated under conditions that would exist in the completed machine. Pressures below 2 x 10^{-11} Torr beam vacuum requirement and below 2 x 10^{-7} Torr insulating vacuum, were routinely achieved during all phases of the Full Cell operation and support systems testing.

1087 **(CAPE—2883) SLAC 16-channel differential scanning analog (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 19 Nov 1979. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the drawing list provide the data and specifications for constructing a SLAC 16-channel differential scanning analog to digital converter as used in the PEP Storage Ring Instrumentation and Control System. This device is a CAMAC 16-channel A/D converter which samples voltages or readings on various elements of the storage ring magnet system, or other device read back signals.

1088 **(CAPE—2884) SLAC MK III solenoid main cooling water manifold (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 10 Apr 1980. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

Portions are illegible in microfiche products2 35-mm aperture cards.

The drawings listed on the auxiliary drawing list provide the layout and information for constructing the solenoid cooling water manifold on the MK III Detector as used in the SLAC PEP Storage Ring. This assembly distributes the water to the various segments of the solenoid and provides a common return via the output manifold.

1089 **(CAPE—2885) SLAC 8-channel analog output module (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 4 Aug 1982. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the drawing list provide the data and specifications for constructing an 8-channel CAMAC output module as used on the SLAC PEP Storage Ring's Instrumentation and Control System. The device is a general type of interface which provides analog output voltages which can, for example, control magnet trim supplies.

1090 **(CAPE—2886) SLAC 16-channel latched relay output module (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 4 Mar 1981. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the drawing list provide the data and specifications for constructing a 16-channel latched relay output module which provides an interface from a general type of CAMAC interface module to drive relays for various control functions. This is part of the large Instrumentation and Control System at the SLAC PEP Storage Ring.

1091 **(CAPE—2887) SLAC CAMAC analog output distribution module (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 1 Aug 1979. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

Portions are illegible in microfiche products9 35-mm aperture cards.

The drawings listed on the drawing list provide the data and specifications for constructing a CAMAC analog output distribution module as used on the SLAC PEP Storage Ring Instrumentation and Control System. The device is an interface unit which provides a means of distributing CAMAC signals to another device which then distributes signals to actual controlling devices and then, for example, to power supplies for magnets, magnet trim supplies and others.

1092 **(CAPE—2888) SLAC 16-channel differential TTL output module (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 5 Apr 1983. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

Portions are illegible in microfiche products3 35-mm aperture cards.

The drawings listed on the Drawing List provide the data and specifications for constructing a SLAC 16-channel differential TTL output module as used in the SLAC PEP storage ring instrumentation and control system. It is a CAMAC module used as an output interface module from CAMAC signals.

1093 **(CAPE—2889) SLAC PEP dc-current transformer system (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 5 Feb 1981. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The two drawings listed and those listed on the drawing list provide the data and specifications for constructing a DC-Current Transformer System as used on several power supplies in the SLAC PEP magnet system. The system consists of a DC-Current Transformer Readout, a DC Current Transformer Receiver, and a DC-Current Transformer Driver.

1094 **(CAPE—2890) SLAC analog input distribution unit (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 5 Jan 1981. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the drawing list provide the data and specifications for constructing the analog input distribution unit as used on the SLAC PEP Storage Ring Instrumentation and Control System. The device provides a means of distributing input analog signals to CAMAC modules or other devices. For example, it takes the output of an 8-channel analog output device and distributes to the inputs of the proper CAMAC modules.

1095 **(CAPE—2891) SLAC 16-channel pulsed relay output module (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 4 Mar 1981. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the drawing list provide the data and specifications for constructing a 16-channel pulsed relay output module as used at the SLAC PEP Storage Ring to control certain power supplies such as the Magnet Trim power supplies. This is a CAMAC crate module which provides relay drive to control power supply functions such as On-Off, Reverse Voltage, and Voltage Level.

1096 **(CAPE—2893) SLAC PEP transverse feedback system (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 31 Oct 1983. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the master auxiliary drawing list provide the data and specifications for constructing the Transverse Feedback System as used on the SLAC PEP Storage Ring. The drawings cover all of the electronics of the system as shown on the system block diagram BD 209-300-00-R2. The beam line components are not included with this set of drawings, namely the strip line pickup mechanical assemblies. The system detects transverse positions of the circulating beams and through electronic circuits and computer control the beams are returned to their correct orbits.

1097 **(CAPE—2894) SLAC SPEAR magnet bus arrangement (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 7 Oct 1977. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The listed wiring and schematic diagrams provide the data and layout of the wiring for the magnets in the SPEAR electron-positron storage ring at SLAC. These drawings are schematic in nature and do not show actual detail of the actural wiring in the ring.

1098 **(CAPE—2897) SLAC SPEAR beam position monitor (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 26 May 1976. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The assembly drawing provides the basic outline of the typical beam position and feedback monitor assembly as used on the SLAC SPEAR electron-positron storage ring. This assembly provides beam position information used to observe the beam's position and to provide feedback signals to control the position characteristics of the beam. Subdrawings are not included.

1099 **(CAPE—2898) SLAC 16-bit digital input module (single document) (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 25 Nov 1980. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the Drawing List provide the data and specifications for constructing a single channel SLAC PEP 16-bit digital input module as used on the PEP Storage Ring Instrumentation and Control System. This device is a typical interface unit taking digital information and converting to analog voltages.

1100 **(CAPE—2899) SLAC 16-channel multiplex digital input assembly (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 1 Dec 1980. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the drawing list provide the data and specifications for constructing a 16 channel multiplex digital input assembly. It fits a standard CAMAC crate and provides 16 channels of 16 bit output. It is used primarily as an interface in PEP's Instrumentation and Control System. It is a general purpose type of unit using standard techniques.

1101 **(CAPE—2901) SLAC MARK III time of flight scintillator (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 22 Oct 1980. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The listed drawings provide the information for constructing a portion of the SLAC MARK III Time of Flight counter-scintillator. The scintillation material detects passage of charged particles which produce a flash of light which can be detected and used as timing points in time. This device was used on the MARK III detector in the SLAC SPEAR Storage Ring.

1102 **(CAPE—2907) SLAC SPEAR misc. vacuum chambers, transitions and tools (Engineering Materials).** (Stanford Linear Accelerator Center, CA (USA)). 9 Feb 1973. Contract AC03-76SF00515. TIC, PO Bx 62, Oak Ridge, TN 37831.

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The drawings listed on the auxiliary drawing list provide the data and construction details for a selected few of the SPEAR vacuum chambers (A and B), a geometry layout for an interaction region, and miscellaneous transitions, flange adapters and brackets. These devices are part of the beam line hardware used on the SLAC SPEAR positron-electron storage ring.

1103 **(LBL—16592) X-ray lithography using wiggler and undulator synchrotron-radiation sources.** Neureuther, A.R.; Kim, K.J.; Thompson, A.C.; Hoyer, E. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 11p. (CONF-8310172—2). NTIS, PC A02/MF A01. Order Number DE84001875.

From Advances in soft x-ray science and technology conference; Upton, NY, USA (17 Oct 1983).

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A systems design approach is used to identify feasible options for wiggler and undulator beam lines for x-ray lithography in the 0.5 to 0.2 μm linewidth region over 5 cm by 5 cm fields. Typical parameters from the Wiggler and Undulator in the Advanced Light Source designed at the Lawrence Berkeley Laboratory are used as examples. Moving from the conventional wavelengths of 4 to 9 A to very soft wavelengths around 15 A is shown to be very promising. The mask absorber thickness can be reduced a factor of three so that 0.2 μm features can be made with a 1:1 mask aspect ratio. The mask heating limited exposure time is also reduced a factor of three to 3 sec/cm^2. However, extremely thin beam line windows (1/4 mil Be) and mask supports (1 μm Si) must be used. A wiggler beam line design using a small slit window at a scanning mirror appears feasible. A unconventional, windowless differentially pumped beam line with dual deflecting mirrors could be used with an undulator source.

1104 **(SLAC-PUB—3172) Beam-blowup study for a weak-strong case.** Kheifets, S.; Helm, R.; Shoaee, H. (Stanford Linear Accelerator Center, CA (USA)). Jul 1983. Contract AC03-76SF00515. 3p. (CONF-830822—35). NTIS, PC A02/MF A01. Order Number DE84001608.

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

A comparison is made of experimental results obtained on two SLAC storage rings PEP and SPEAR with the theoretical calculations and the dependence of the phenomenon on different machine parameters is studied. In the present paper we present such a comparison with reasonably good agreement between the experiment and the theory. The important conclusion from our study is that any valid theory of the beam-beam phenomenon should take into account the asymmetries of the machine parameters arising in any storage ring from all kinds of machine imperfections.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 293, 886, 1088, 1101

1105 **(BNL—33703) Channel electron multiplier and optically coupled amplifier used as an incident-flux monitor.** Smith, G.C.; Williams, G.P. (Brookhaven National Lab., Upton, NY (USA)). Sep 1983. Contract AC02-76CH00016. 12p. (CONF-830910—2). NTIS, PC A02/MF A01. Order Number DE84001451.

From 3. national conference on synchrotron radiation instrumentation; Upton, NY, USA (12 Sep 1983).

A system is described that performs monitoring of the incident photon flux for synchrotron-radiation experiments. The system uses a channel electron multiplier whose output signal current, in the high-voltage line, is accurately measured with an optically coupled isolation amplifier.

1106 **(BNL—33724) Focusing x-ray monochromator for EXAFS studies in the energy range 4-30 keV.** Heald, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 13p. (CONF-830910—4). NTIS, PC A02/MF A01. Order Number DE84001903.

From 3. national conference on synchrotron radiation instrumentation; Upton, NY, USA (12 Sep 1983).

The design and operating principles of a focusing x-ray monochromator are described. Consistent with extended x-ray absorption fine structure (EXAFS) applications it allows rapid tuning while maintaining high energy resolution and a fixed focus at the sample. The basic instrument consists of two opposing two crystal monochromators with the second and third crystals operating as a dispersive monochromator. This provides the intrinsic resolution of the crystals independent of silt settings or source size effects. Focusing is achieved by a sagittally bent fourth crystal. To maintain a fixed focus two options are available. In the first, the second crystal pair is translated while the radius of the fourth crystal is held fixed. Thus, the focus remains at the sample even though the angle of incidence on the bent crystal is changing. In the second option the radius of the bent crystal is changed dynamically as the scan is carried out. These techniques are compared and a crystal bender designed for rapid tuning is described.

1107 **(BNL—33736) Memory intensive functional architecture for distributed computer control systems.** Dimmler, D.G. (Brookhaven National Lab., Upton, NY (USA)). Oct 1983. Contract AC02-76CH00016. 7p. (CONF-831015—13). NTIS, PC A02/MF A01. Order Number DE84002579.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

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A memory-intensive functional architectue for distributed data-acquisition, monitoring, and control systems with large numbers of nodes has been conceptually developed and applied in several large-scale and some smaller systems. This discussion concentrates on: (1) the basic architecture; (2) recent expansions of the architecture which now become feasible in view of the rapidly developing component technologies in microprocessors and functional large-scale integration circuits; and (3) implementation of some key hardware and software structures and one system implementation which is a system for performing control and data acquisition of a neutron spectrometer at the Brookhaven High Flux Beam Reactor. The spectrometer is equipped with a large-area position-sensitive neutron detector.

1108 **(CRN-PN—82-11) Development of a fast neutron dosemeter SAD 1.** Jung, M.; Francois, H.; Heilmann, C.; Demoulin, R.; Kappler, A.; Oppel, R. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Nov 1982. 11p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703743.

Studies were carried out in the framework of a program for monitoring personnel for contamination by fast neutrons and for measuring doses in the 20 to 30 m rem range. The dosimeter considered consists of a nuclear emulsion with a response enhanced by a polyethylene converter. The response to fast neutrons with energies in excess of 100 keV and to the gamma radiation background (subsequently subtracted) was tested.

1109 **(DOE/NBM—4001927) Development report: a RADIAC system for measuring aqueous tritium concentration by the liquid scintillation method.** Coleman, G.A.; Allin, G.W.; De Lorenzo, J.T.; Phelps, J.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 90p. NTIS, PC A05/MF A01. Order Number DE84001927.

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This report describes the design, assembly, and testing of a room temperature bench-scale liquid scintillation system for aqueous tritium measurement. With this system urine or water samples with tritium concentrations of 1 to 5 microCuries per liter can be measured within 20% uncertainty in a typical counting time of 40 seconds to 3 minutes, depending on the background count rate, activity level, and degree of quench. Concentrations above 5 μCi/L can be measured with 10% uncertainty in a typical counting time of less than 3 minutes. In water samples, tritium concentrations as low as 0.1 μCi/L can be measured within 20% uncertainty in a typical counting time of 30 minutes, and within 30% uncertainty in less than 10 minutes. These operating parameters may be modified if necessary. For instance, changing the minimum measurable activity from 1 μCi/L to as little as 0.1 μCi/L can be accomplished by a simple change in the operating program. The microprocessor incorporated into this system collects, processes, and transmits data and also interacts with the operator, which minimizes the work load and thereby reduces the chance of operator-induced error. Very little training is required: the operator simply follows basic instructions on the display. A novel photomultipiler tube balance circuit was developed especially for use with this system. It maximizes counting efficiency and eliminates the need for stocking matched pairs of photomultiplier tubes. The design of the signal processing system is based on the use of a fast coincidence gate. This eliminates the need for refrigerating the scintillator or storing it in the dark. The design of the system also allows the degree of quench for a particular sample to be determined without the use of a radioactive gamma source. Gamma sources are used to determine quench in many commercial liquid scintillation counters.

1110 **(HEDL-SA—2847-FP) Status of automated nuclear scanning systems.** Gold, R.; Roberts, J.H.; Preston, C.C.; McNeece, J.P.; Ruddy, F.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1983. Contract AC06-76FF02170. 25p. (CONF-830969—5). NTIS, PC A02/MF A01. Order Number DE84001494.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

Present day minicomputers and microprocessors enable a range of automation, from partial to total, of tasks once thought beyond approach. The status of three computer controlled systems for quantitative track measurements is reviewed. Two systems, the Hanford optical track scanner (HOTS) and an automated scanning electron microscope (ASEM) are used for scanning solid state track recorders (SSTR). The third systems, the emulsion scanning processor (ESP), is an interactive system used to measure the length of proton tracks in nuclear research emulsions (NRE). Current limitations of these systems for quantitative track scanning are presented. Experimental uncertainties attained with these computer controlled systems are described using results obtained from reactor neutron dosimetry.

1111 **(HEDL-SA—2859-FP) Imaging of fast-neutron sources using solid-state track-recorder pinhole radiography.** Ruddy, F.H.; Gold, R.; Roberts, J.H.; Kaiser, B.J.; Preston, C.C. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1983. Contract AC06-76FF02170. 6p. (CONF-830969—3). NTIS, PC A02/MF A01. Order Number DE84001466.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

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Pinhole imaging methods are being developed and tested for potential future use in imaging the intense neutron source of the Fusion Materials Irradiation Test (FMIT) Facility. Previously reported, extensive calibration measurements of the proton, neutron, and alpha particle response characteristics of CR-39 polymer solid state track recorders (SSTRs) are being used to interpret the results of imaging experiments using both charged particle and neutron pinhole collimators. High resolution, neutron pinhole images of a ^{252}Cf source have been obtained in the form of neutron induced proton recoil tracks in CR-39 polymer SSTR. These imaging experiments are described as well as their potential future applications to FMIT.

1112 **(HEDL-SA—2864-FP) Optical efficiency for fission-fragment track counting in Muscovite Solid-State Track Recorders.** Roberts, J.H.; Ruddy, F.H.; Gold, R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1983. Contract AC06-76FF02170. 10p. (CONF-830969—6). NTIS, PC A02/MF A01. Order Number DE84001477.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

In order to determine absolute fission rates from thin actinide deposits placed in direct contact with Muscovite Solid-State Track Recorders, it is necessary to know the efficiency with which fission-fragment tracks are recorded. In this paper, a redetermination of the optical efficiency, i.e., the fraction of fission events recorded and observed in the Muscovite, is reported. The value obtained from a well-calibrated thin deposit of ^{252}Cf and Muscovite etched about 90 min. in 49% HF at room temperature, is 0.9875 +- 0.0085. Manual counting was used. Preliminary results from a deposit of ^{243}Pu are also reported, along with preliminary comparisons of track counting with an automated system. Reasons for the discrepancy of the optical efficiency reported here with an earlier measurement are also reported. 5 references, 1 figure, 3 tables.

1113 **(LA—9642) Background-subtract adjustment for plutonium continuous alpha air monitors using ^{252}Cf.** Cucchiara, A.L.; Stafford, R.G.; McAtee, J.L. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01. Order Number DE84002287.

We investigated a method to make optimum adjustments to the electronic background-subtract circuit of a continuous air monitor (CAM) by using a californium source instead of a background air sample. We observed spectra of detected alpha particles emitted by radon-thoron daughters and a californium source on a multichannel analyzer connected to a CAM to determine their effect on the behavior of the subtract circuit. The californium source alpha energy spectrum simulates the spectra of ^{218}Po and ^{212}Bi, the radon-thoron daughters most likely to cause spurious CAM alarms. This simulation was the basis for deriving an empirical method using californium to adjust the background-subtract circuit.

1114 **(LA—9855-M) Delta-count rate-monitoring system.** Van Etten, D.; Olsen, W. (Los Alamos National Lab., NM (USA)). Sep 1983. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01. Order Number DE84002312.

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A delta-count rate-monitoring system for detection of small changes of low-level gamma radiation was designed for Group HSE-8's environmental surveillance and accident response van. The system is used to locate areas of radioactive contaminants in the environment where surveys with standard instruments would be very difficult because of large areas to cover. An audible alarm sounds when the detected radiation level exceeds the set background by a predetermined amount, and a strip chart recorder may be used to record the data.

1115 **(LA-UR—83-2839) Track reconstruction of normal muon decays in the LAMPF TPC: one working scheme.** McKee, R.J. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 21p. (CONF-8306139—1). NTIS, PC A02/MF A01. Order Number DE84001033.

From Time projection chamber workshop; Vancouver, Canada (23 Jun 1983).

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A working scheme for track reconstruction of normal muon decays in the LAMPF TPC is here outlined. Muon tracks stopping in the TPC and helical electron tracks from muon decay are both identified and fitted for complete event reconstruction. Because of certain geometrical characteristics of the TPC, novel techniques are deployed to find the tracks. Normal road tracing methods do not work reliably; they are replaced by, among other things, a random search technique that locates the helix's planar projection and a carefully worked-out method for correctly putting each coordinate on its proper turn in the helix.

1116 **(LA-UR—83-2909) Gamma-ray detectors for intelligent, hand-held radiation monitors.** Fehlau, P.E. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-831015—7). NTIS, PC A02/MF A01. Order Number DE84001868.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Small radiation detectors based on HgI_2, bismuth germanate (BGO), plastic, or NaI(Tl) detector materials were evaluated for use in small, lighweight radiation monitors. The two denser materials, HgI_2 and BGO, had poor resolution at low-energy and thus performed less well than NaI(Tl) in detecting low-energy gamma rays from bare, enriched uranium. The plastic scintillator, a Compton recoil detector, also performed less well at low gamma-ray energy. Two small NaI(Tl) detectors were suitable for detecting bare uranium and sheilded plutonium. One became part of a new lightweight hand-held monitor and the other found uses as a pole-mounted detector for monitoring hard-to-reach locations.

1117 **(LA-UR—83-2941) Violinist: sophisticated Pu field monitor.** Umbarger, C.J.; Wolf, M.A.; Trujillo, F. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 3p. (CONF-831015—8). NTIS, PC A02/MF A01. Order Number DE84001717.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A new, smart, portable multichannel analyzer-based plutonium field monitor has been developed that will significantly improve field monitoring capability by accident response teams. Called the Violinist, the system uses the ever-popular thin NaI(Tl) detector developed some years ago. The electronics weigh 1.7 lb and fit inside a package 7" x 5" x 1-3/4" deep. The device has: 256 channel MCA; microcomputer control; 32 x 84 dot matrix LCD alphanumeric and spectral display; three independent cursor sets for region of interest definition; keyboard-entered constants (3); computation algorithms; and internal battery power (15 hr lifetime). The package has wide radiation monitoring applications.

1118 **(LA-UR—83-2942) New-generation low-power radiation survey instruments.** Waechter, D.A.; Bjarke, G.O.; Wolf, M.A.; Trujillo, F.; Umbarger, C.J. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-831015—5). NTIS, PC A02/MF A01. Order Number DE84001716.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A number of new, ultra-low-powered radiation instruments have recently been developed at Los Alamos. Among these are two instruments which use a novel power source to eliminate costly batteries. The newly developed gamma detecting radiac, nicknamed the Firefly, and the alpha particle detecting instrument, called the Simple Cordless Alpha Monitor, both use recent advances in miniaturization and power-saving electronics to yield devices which are small, rugged, and very power-frugal. The two instruments consume so little power that the need for batteries to run them is eliminated. They are, instead, powered by a charged capacitor which will operate the instruments for an hour or more. Both line power and mechanical sources are used to charge the storage capacitors which power the instruments.

1119 **(LA-UR—83-2958) Computerized plutonium wound-analysis system.** Waechter, D.A.; Brake, R.J.; Vasilik, D.G.; Erkkila, B.H. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-831015—6). NTIS, PC A02/MF A01. Order Number DE84001713.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A new plutonium wound monitor has been developed at Los Alamos to upgrade a system which has been in use for about five years. The instrument, called a Computerized Wound Screening System, is designed around a readily available personal computer. It includes a full-function 256-channel pulse height analyzer and software necessary to calculate plutonium and americium activity from a spectrum. This new system provides medical and health physics personnel with considerable flexability in recognizing and recording

situations where a wound incurred in a plutonium processing facility might be contaminated. This flexibility includes fast, accurate determination of contaminants in a wound, hard copy printout of results, and full patient logging capabilities via flexible disk storage. Use of a low cost computer greatly simplifies hardware and software design, and makes duplication of the instrument very simple and inexpensive.

1120 **(LA-UR—83-2959) Portable beta spectrometer/dosimeter.** Erkkila, B.H.; Waechter, D.A.; Brake, R.J. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 6p. (CONF-831015—9). NTIS, PC A02/MF A01. Order Number DE84001714.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

As part of an ongoing program to upgrade health and safety radiation survey instruments, the Los Alamos National Laboratory has developed a portable, battery-operated, computerized beta spectrometer/dosimeter. The instrument will support many different detectors, but the one chosen here is a combination plastic scintillator and NaI crystal. The instrument includes pulse conditioning circuits, 128-channel pulse height analyzer with integral liquid crystal display, and a microcomputer system which calculates dose and dose rate from betas incident on the detector. Instrument operating life is about 8 hours between charges. The instrument will, at the user's option, display a beta spectrum or the accumulated dose in millirad, as well as give the user beta dose rates in millirad per hour. Data accumulated in the instrument can be read out through an RS-232 serial port on the instrument. The entire unit weighs 8 pounds, including internal batteries, and is packaged in a small case 25-cm long, 15-cm wide, and 15-cm high.

1121 **(LA-UR—83-3009) Efficiency of a bismuth-germanate scintillator: comparison of Monte Carlo calculations with measurements.** Hsu, H.H.; Dowdy, E.J.; Estes, G.P.; Lucas, M.C.; Mack, J.M.; Moss, C.E.; Hamm, M.E. (Los Alamos National Lab., NM (USA); Technical Programming Services, Pleasanton, CA (USA)). 1983. Contract W-7405-ENG-36. 6p. (CONF-831015—10). NTIS, PC A02/MF A01. Order Number DE84001703.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Monte Carlo calculations of a bismuth-germanate scintillator's efficiency agree closely with experimental measurements. For this comparison, we studied the absolute gamma-ray photopeak efficiency of a scintillator (7.62 cm long by 7.62 cm in diameter) at several gamma-ray energies from 166 to 2615 keV at distances from 0.5 to 152.4 cm. Computer calculations were done in a two-dimensional cylindrical geometry with the Monte Carlo coupled photon-electron code CYLTRAN. For the experiment we measured 11 sources with simple spectra and precisely known strengths. The average deviation between the calculations and the measurements is 3%. Our calculated results also closely agree with recently published calculated results.

1122 **(MPI-PAE/Exp.El.—117) Segmented photon-hadron calorimeter using a two coloured wavelength shifter optical readout system.** Marzo, C. de; Palma, M. de; Distante, A.; Favuzzi, C.; Ferrorelli, R.; Lavopa, P.; Maggi, G.; Perchiazzi, M.; Posa, F.; Ranieri, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Jun 1983. 33p. Available from Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.).

The construction and performance of two segmented scintillator photon and hadron calorimeters (a ring and a downstream calorimeter) are described. They were used in an experiment (NA5) at the CERN SPS to study deep inelastic hadron-hadron collisions. A novel light collection system was developed using acrylic rods doped with two different colour wavelength shifter materials (Yellow 323 and BBQ). This allowed signals from the photon and hadron calorimeter to be transmitted by a common readout rod and rendered a compact and economical construction of the calorimeters.

1123 **(OEFZS-A—0415) Development of a portable calorimeter for measurement of the dose rate of ionizing radiation.** Duftschmid, K.E.; Witzani, J. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Apr 1983. 18p. (In German). (ST—108/83). Available by the author, OEFZS, A-2444 Seibersdorf, Austria.

Limited Distribution.

In radiation dosimetry the quantity 'exposure' (unit 'Roentgen') has been most frequently used for primary standard measurements in the past time. This quantity, however, is only defined for photon radiation up to 3 MeV. Due to the increasing application of high energy photon- and electron radiation, in particular in radiation therapy, exposure has been replaced by a new quantity 'adsorbed dose' (unit 'Gray'). In view of this development the new international system of units (SI) has dropped the unit 'Roentgen'. The primary standard for exposure are free-air-ionization-chambers, while for adsorbed dose, calorimeters have to be used, which allow for the conversion of absorbed dose mesurement into heat. Up to now calorimeters used in large primary laboratories have been most complicated, cumbersome and not portable. Based on the design of Dr. Steve Domen at the US National Bureau of Standards a new portable graphite absorbed dose calorimeter with heat-loss compensation has been manufactured in cooperation with Domen and the Hungarian Office of Measures. The test results of the prototype instrument showed an improvement in limit of detection of one order of magnitude due to the AC-Wheatstone Bridge circuitry and an additional microthermistor in the calorimeter core. Four complete units are being presently manufactured at the Austrian Research Center Seibersdorf and will eventually be used as primary standard for absorbed dose measurement in Austria, Hungary, Italy and the IAEA Dosimetry Laboratory.

1124 **(PNL—3983) Performance comparisons of selected personnel-dosimetry systems in use at Department of Energy facilities.** Roberson, P.L; Holbrook, K.L.; Yoder, R.C.; Fox, R.A.; Hadley, R.T.; Hogan, B.T.; Hooker, C.D. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 84p. NTIS, PC A05/MF A01. Order Number DE84001810.

Dosimeter performance data were collected to help develop a uniform approach to the calibration and use of personnel dosimetry systems for Department of Energy (DOE) laboratories. Eleven DOE laboratories participated in six months of testing using the American National Draft Standard, Criteria for Testing Personnel Dosimetry Performance, ANSI N13.11, and additional testing categories. The tests described in ANSI N13.11 used a pass/fail system to determine compliance with the draft standard. Recalculation to PNL irradiations showed that the ^{137}Cs, $^{90}Sr/^{90}Y$, and ^{252}Cf categories can be recalibrated to have acceptable performance for nearly all participant systems. Deficient dosimeter design or handling techniques caused poor performance in the x-ray category for nearly half of the participants. Too little filtration for the deep-dose element caused poor performance in the beta/photon mixture category for one participant. Two participants had excessively high standard deviations in the neutron category due to dosimeter design or handling deficiencies. The participating dosimetry systems were separated into three categories on their dose evaluation procedure for low-energy photons. These were film dosimeters, fixed-calibration thermoluminescent (TL) dosimeters, and variable-calibration TL dosimeters. The performance of the variable-calibration design was best while the film dosimeters performed considerably worse than either TL dosimeter design. Beta energy dependence studies confirmed a strong correlation between sensitive element thickness, shallow element filtration and low-energy beta response. Studies of neutron calibration conditions for each participant suggested a relationship between response and calibration facility design.

1125 **(TU-Inf—05-15-81) Photocurrent measurements at HgI_2 single crystals doped with iodine.** Mueller, K.; Schulz, A.I. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 1981. 16p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704269.

The paper presents the measurements of photoconductivity at two HgI_2 single crystal samples doped with iodine in concentra-

tions of 0.3 and 1.2 wt%. After measuring photocurrent the samples were cleft in detector slices. The photocurrent I/sub Ph/ was investigated versus irradiation intensity I/sub L/ at constant wavelength (lambda = 555...570 nm) and is given by I/sub Ph/ proportional to I/sub L//sup γ/. The I/sub L/-I/sub Ph/-curves were characterized by the slope, the γ-value. A dependence of γ-value on voltage was not observed. The slices of sample doped with iodine in concentration 0.3 wt% having exhibited a γ-value of 0.95 wt% showed a nearly linear photoconductivity and better detection properties than slices of sample doped with iodine in concentration 1.2 wt% at which lower γ-values have been measured. In this manner between photocurrent and detection properties a relationship could be pointed out. It can be assumed, that the determination of photocurrent and estimation of γ-value allow a prediction of detector properties.

1126 **Relativistic rise measurements with very fine sampling intervals.** Ludlam, T.; Platner, E.D.; Polychronakos, V.A.; Lindenbaum, S.J.; Kramer, M.A.; Teramoto, Y. (Brookhaven National Lab., Upton, NY). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-28: No. 1, 439-444(Feb 1981). Contract AC02-76CH00016.

The motivation of this work was to determine whether the technique of charged particle identification via the relativistic rise in the ionization loss can be significantly improved by virtue of very small sampling intervals. We used a fast-sampling ADC and a longitudinal drift geometry to provide a large number of samples from a single drift chamber gap, achieving sampling intervals roughly 10 times smaller than any previous study. A single layer drift chamber was used, and tracks of 1 meter length were simulated by combining together samples from many identified particles in this detector. Using these data we have studied the resolving power for particle identification as a function of sample size, averaging technique, and the number of discrimination levels (ADC bits) used for pulse height measurements.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 486

1127 **(BNL—33692) Radiation damage in silicon detectors.** Kraner, H.W. (Brookhaven National Lab., Upton, NY (USA)). Aug 1983. Contract AC02-76CH00016. 10p. (CONF-8306110—3). NTIS, PC A02/MF A01. Order Number DE84001460.

From 2. Pisa meeting on advanced detectors; Castiglione della Pescaia, Italy (2 Jun 1983).

A review is presented of the effects of radiation damage on silicon detectors which are being considered for high energy physics applications. The main degradation in performance is an increase in leakage current, which can be well characterized by an empirical damage constant for many radiations. A summary of data on damage constants is given. A brief discussion of annealing effects in terms of band gap level changes is included.

1128 **(DOE/NBM—4002064) Studies of the interactions of ionizing radiations with communications materials.** Ashley, J.C.; Williams, M.W. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01. Order Number DE84002064.

Various models were developed for calculating the energy loss per unit length, or stopping power, and the inelastic mean free path for electrons in a material. We have included both organic materials such as polyethylene and inorganic materials such as SiO_2. In each case, the calculated values of stopping power and mean free path have been compared with experimental values where available and, in the case of mean free paths for organic materials, with those predicted from our universal formula. In addition the various models for stopping power and mean free path have been compared with each other. Measurements have been made of electron attenuation lengths (as electron mean free paths) as a function of incident electron energy for electrons in amorphous carbon films, as a direct check on the values predicted by our universal formula for electron mean free paths in solid organic insulators. A theory has been developed to describe charged-particle track structure in nonmetallic solids, as the track evolves in time and space. Work has continued in the field of microdosimetry with the calculation of the energy densities deposited by high-energy photons as a function of depth in traversing a SiO_2 slab sandwiched between two slabs of Si.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 1, 64, 126, 339, 549, 899, 900, 967, 1019

1129 **(BDX—613-2961) Description of a method and artifact for estimating volumetric uncertainty of coordinate measuring machines. Final report.** Jones, L.L.; Grice, J.V. (Bendix Corp., Kansas City, MO (USA)). Nov 1983. Contract AC04-76DP00613. 104p. NTIS, PC A06/MF A01. Order Number DE84002017.

Methodology that expresses the volumetric uncertainty of coordinate measuring machines (CMMs) in a single index is developed. A Latin Square Three-Dimensional Ball Plate (LS3DBP) is the artifact used to obtain statistically balanced data that are analyzed using Latin square analysis of variance (AOV) to provide quantitative estimates of systematic and random error in the CMM measurement system. Estimates of systematic and random error for the nominal values assigned to the LS3DBP are obtained from analysis of calibration data using one-way AOV. A single index, expressed in radial distance, is obtained by combining the systematic and random errors of the artifact and CMM measurement system with the fixed error assigned to the primary measurement system. The Latin square analysis is also used to identify 15 single sources of error in machine geometry by interpretation of the form of axis effects and by using one- and two-dimensional plots. The notation and methodology developed can be extended to measurement systems other than CMMs. It is currently being used to evaluate robotics machines and numerical control milling machines. The use of the LS3DBP requires 70 percent less time than some conventional techniques to estimate CMM uncertainty in volumetric space.

1130 **(BDX—613-2962) Coordinate-measuring machine capability.** Russell, R.J. (Bendix Corp., Kansas City, MO (USA)). Nov 1983. Contract AC04-76DP00613. 45p. NTIS, PC A03/MF A01. Order Number DE84002014.

Three-axis measuring machines have complex geometric and displacement errors. Many machine users are unaware of these systematic errors and think only in terms of the three-scale or displacement errors which may be significantly smaller in magnitude than the geometric errors. A method of estimating the volumetric uncertainty of five coordinate measuring machines (CMMs) was established and the measurement uncertainty is reported for a 20 by 18 by 12 in. work zone. The Latin-Square Three-Dimensional Ball Plate (LS3DBP) and the Space Master Ball Plate (SMBP) were the volumetric standards selected for the evaluation. Data from each ball plate were transformed into new coordinates and compared to previous calibration or reference data. The deviation between measured and referenced values was recorded. These data were used to determine a quantitative estimate of the CMMs measurement capability in X, Y, and Z space by using the Analysis of Variance Technique (AOV). Similar results were obtained from each standard. The precision and uncertainty for each machine was determined and the results ranged from 120 to 150 μin precision and from 270 to 350 μin uncertainty. An evaluation of a larger work volume on each of the five machines is desired to support existing measurement requirements.

1131 **(BNL—33743) Investigation on low pressure limit of Bayard-Alpert gauge.** Chou, T.S.; Lanni, C.; Tang, Z.Q. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 20p. (CONF-831171—9). NTIS, PC A02/MF A01. Order Number DE84002578.

From American Vacuum Society meeting; Boston, MA, USA (1 Nov 1983).

In order to extend the pressure measurement of devices used in most UHV applications to the lowest limit possible, several commercial Bayard-Alpert gauges have been modified. These modified gauges have been inserted into a stainless steel tube with an I.D. of

1-3/4 inches (44.5 mm), which will act as an outer casing for the gauge. A hairpin filament, instead of a commercial helical filament, has been used in this experiment for its accuracy in positioning the filament to improve the gauge performance. In this paper, the characteristics of this modified gauge will be discussed. This includes the variations of the gauge sensitivity on applied voltage and position of the filament. The quantities of the normal and reverse x-ray photo current and possibility of self-modulation will be presented. From the results of this study, the potential of this gauge to measure pressures down to 10^{-13} Torr range with lower emission current is strongly indicated.

1132 **(CBPF-NF—044/81) Charge oscillations in orbitrons.** Porto, M.; Gomes, L.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1981. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83704246.

A statistical model for the electron distribution in orbitrons is constructed where the effect of the end plates is considered. A comparison is made with the measured density of charge. The electromagnetic oscillations generated by orbitrons are calculated as pressure waves and the results obtained are compared with the data.

1133 **(CONF-8210209—1) Flat insulation tester that uses an unguarded nichrome screen wire heater.** McElroy, D.L.; Graves, R.S.; Yarbrough, D.W.; Moore, J.P. (Oak Ridge National Lab., TN (USA); Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1982. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE84001986.

From Guarded hot plate seminar; Quebec, Canada (7 Oct 1982).

An unguarded, longitudinal heat flow technique is described for measuring the apparent thermal conductivity (λ/sub a/) of insulating materials in the range 300 to 330 K. Vertical heat flow is generated by a 0.9 m by 1.5 m electrically heated nichrome screen that is instrumented and sandwiched between two test samples. The test samples are bounded by two temperature-controlled copper plates. The system has been used to measure fiberglass batts and obtain data that show the effects of density, temperature, temperature difference, thickness, plate emittance and heat flow direction on λ/sub a/. A determinate error analysis indicates a λ/sub a/ measurement uncertainty of +- 1.5%. The system repeatability and reproducibility were found to be +- 0.2%. The measured performance of the tester agrees with that predicted by a thermal model. Analysis of the transient characteristics of the screen when it is subjected to a step change in power suggests that the apparatus can be used to determine apparent thermal diffusivity.

1134 **(LA-UR—83-3042) Nanosecond image-shuttering studies at Los Alamos National Laboratory.** Yates, G.J.; King, N.S.; Jaramillo, S.A.; Noel, B.W.; Gobby, P.L.; Aeby, I.; Detch, J.L. (Los Alamos National Lab., NM (USA); EG and G, Inc., Goleta, CA (USA)). 1983. Contract W-7405-ENG-36. 7p. (CONF-831015—11). NTIS, PC A02/MF A01. Order Number DE84001733.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Experimental results comparing gated imaging capabilities of proximity-focused microchannel-plate intensifiers and electrostatically-focused silicon-intensified-target vidicons are presented. A brief summary of previous response data obtained from several standard and modified versions of both image sensors and current efforts on (1) sector gating of segmented photocathodes (2) prepulsing of photocathodes with infrared light to increase conductivity and (3) gate pulse injection techniques are discussed. Segmented photocathodes increased gating speed by simultaneous turn-on individual sectors whereas preliminary analyses indicate no improvements from infrared illumination.

1135 **(LA-UR—83-3060) Using photoconductivity to improve image-tube gating speeds.** Gobby, P.L.; Yates, G.J.; Jaramillo, S.A.; Noel, B.W.; Aeby, I. (Los Alamos National Lab., NM (USA); EG and G, Inc., Goleta, CA (USA)). 1983. Contract W-7405-ENG-36. 4p. (CONF-831015—12). NTIS, PC A02/MF A01. Order Number DE84001732.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Portions are illegible in microfiche products.

A technique using the photoconductivity of semi-conductor and insulator photocathodes to improve image tube gating speeds is presented. A simple model applicable to the technique and a preliminary experiment are described.

1136 **(LALP—83-44) High-speed videography for optical and x-ray imaging.** Bryant, L.E. Jr. (Los Alamos National Lab., NM (USA)). Sep 1983. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01. Order Number DE84002272.

The SP-2000 Motion Analysis System, or high-speed video, is described, which can record up to 2000 full frames per second or up to 12,000 partial frames per second with a playback speed of 60 frames per second, thus allowing a slowdown factor of up to 200 times in the recorded action. Data are recorded in digital form, and thus the system can interface with a computer. High-speed video is being used to document dynamic events ranging from small-scale laboratory experiments to large field tests. The camera can also be used to monitor the output fluor of an x-ray-sensitive image intensifier for dynamic radiography applications. A typical setup and resulting images are shown. (LEW)

1137 (LBL—15298, pp 4.30-4.43) **Applied physics and laser spectroscopy research.** Amer, N.M.; Cooper, M.S.; Gerlach, R.W.; Hitachi, A.; Imler, W.; Olmstead, M.A.; Skumanich, A.; Wake, D.R.; Wei, D. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

The research philosophy of our group is to apply advanced laser spectroscopy and condensed-matter physics ot energy and environmental problems. Because of the narrow line width and tunability of lasers, unsurpassed sensitivity and specificity can be achieved in detecting trace contaminants of the environment, for example. The advanced state of condensed-matter physics also makes it possible to apply this knowledge to energy production and to test novel methods of energy conversion such as photovoltaic solar cells. Superionic electrical energy storage devices, and the recovery and extraction of oil from abandoned wells and oil shale with lyotropic liquid-crystal emulsifiers. Progress is reported.

1138 **(LBL—15865) Lawrence Berkeley Laboratory general-purpose magnetic-measurement data-acquisition system.** Green, M.I.; Nelson, D.H. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 10p. (CONF-830971—6). NTIS, PC A02/MF A01. Order Number DE84001101.

From 8. international conference on magnet technology and exhibition; Grenoble, France (5 Sep 1983).

The Lawrence Berkeley Laboratory (LBL) Magnetic Measurements Engineering (MME) Group has developed a Real-Time Data Acquisition System (DAS) for magnetic measurements. The design objective was for a system that was versatile, portable, modular, expandable, maintainable, quickly and easily reconfigurable both in hardware and software, and inexpensive. All objectives except the last were attained. An LSI 11/23 microcomputer is interfaced to a clock-calendar, printer, CRT control terminals, plotter with hard copy, floppy and hard disks, GPIB, and CAMAC buses. Off-the-shelf hardware and software have been used where possible. Operational capabilities include: (1) measurement of high permeability materials, (2) harmonic error analysis of (a) superconducting dipoles and (b) rare earth cobalt (REC) and conventional quadrupole magnets, and (3) 0.1% accuracy x-y mapping with Hall probes. Results are typically presented in both tabular and graphical form during measurements. Only minutes are required to switch from one measurement capability to another. Brief descriptions of the DAS capabilities, some of the special instrumentation developed to implement these capabilities, and some planned developments are given.

1139 **(LBL—15899) Magnetic measurements for tuning and operating a hybrid wiggler.** Nelson, D.H.; Green, M.I.; Halbach, K.; Hoyer, E.H. (Lawrence Berkeley Lab., CA (USA)). Sep 1983. Contract AC03-76SF00098. 8p. (CONF-830971—5). NTIS, PC A02/MF A01. Order Number DE84001100.

From 8. international conference on magnet technology and exhibition; Grenoble, France (5 Sep 1983).

A hybrid, vanadium-permendur/rare-earth-cobalt (REC) wiggler has been designed, built, and measured at the Lawrence Berkeley Laboratory (LBL) as a joint project with the Stanford Synchrotron Radiation Laboratory (SSRL) and the Exxon Research and Engineering Company. This paper describes two magnetic measurement techniques used to characterize and tune the wiggler. We describe Hall effect gaussmeter measurements that: (1) confirmed and quantified the wiggler sinusoidal field distributions, and (2) calibrated variable-flux-shunt adjustments, which can provide fine-tuning for individual poles. We also describe measurements of integrals of magnetic induction with integral coils and electronic integrators. Coils and integrators were used to: (1) calibrate the end-pole currents required to zero the half-magnet integrals, (2) measure the horizontal-component integral, and (3) measure variations in single period integrals as functions of longitudinal position in the wiggler.

1140 **(N—8325101) Solar radiometers.** Griffin, F.J. (Eppley Lab., Inc., Newport, RI (USA)). 1981. 11p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 137-148 (SEE N83-25093 14-44).

Solar radiation instrumentation is described. The characteristics of pyrheliometers and pyranometers are discussed.

1141 **(N—8325103) Spectroradiometer measurements in support of photovoltaic device testing.** Zerlaut, G.A.; Maybee, J.D. (DSET Labs., Phoenix, AZ (USA)). 1981. 17p. NTIS, PC A13/MF A01.

In Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 153-166 (SEE N83-25093 14-44).

The spectroradiometer which is capable of complete solar spectral measurements approximately 7 minutes apart in both the global and direct beam modes, all in the wavelength range 280 to 2500nm, is outlined. Global can be measured at any azimuth and altitude position, the field of view of the pyrheliometer comparison tube is 6 deg. It is shown that resolution is sufficient to identify Fraunhofer absorption bands in the surface of the Sun. The relationship between direct beam spectra and two specific microenvironments is shown. The differences for the significance of microenvironment haze and pollution to the efficiency of concentrating photovoltaic devices are analyzed.

1142 **(SAND—83-1639C) Ion-implanted strained-layer superlattice device.** Myers, D.R.; Zipperian, T.E.; Biefeld, R.M.; Wiczer, J.J. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 5p. (CONF-831243—2). NTIS, PC A02/MF A01. Order Number DE84000101.

From International electron device meeting; Washington, DC, USA (5 Dec 1983).

High-quality p-n junction diodes are demonstrated in Be$^+$-implanted GaAs/sub x/P/sub 1-x//GaP strained-layer superlattices (SLSs). This is the first demonstration of electrical activation of an implanted species with useful electrical characteristics in an SLS. X-ray diffraction indicates that the superlattice structure survived the implantation and annealing, and room temperature electrical measurements indicate diode ideality factors of ~ 2.0 over seven decades of forward current for these devices. Diodes formed in SLSs with n-type background doping of $10^{17}cm^{-3}$ exhibit room temperature reverse leakage currents of 1.5×10^{-7} A/cm^2 at ~ 10V. The abrupt avalanche breakdown (at 100 μA) of these unpassivated devices occurs at -18V. The diodes show an uncoated peak external quantum efficiency of 30% for photons with energies slightly above the superlattice bandgap of 2.1eV.

1143 **(SAND—83-8246) Single particle counting diagnostic system for measuring fine particulates at high number densities in research and industrial applications. Final report summarizing instrument development, validation and operating instructions.** Holve, D.J. (Sandia National Labs., Livermore, CA (USA)). Oct 1983. Contract AC04-76DP00789. 106p. NTIS, PC E05/MF A01. Order Number DE84002750.

Includes 1 sheet of 48x reduction microfiche.

Optical methods for particle size distribution measurements in practical high temperature environments have achieved feasibility and offer significant advantages over conventional sampling methods. The present report describes a mobile electro-optical system which has been designed for general use in a wide range of research and industrial environments. Specific features of this system include a method of providing in situ alignment and incorporation of an extinction measurement for application to optically thick aerosol flows. The instrument has demonstrated capability for measuring individual particles in the size range 0.25 to 100 microns at number densities up to $10^{13}/m^3$. In addition to demonstration of the system's wide dynamic range, we show the utility of the in situ alignment method in hot (1100 K) turbulent flows where beam steering can be a problem. As an example of the instrument's application, number and mass frequency distribution measurements of flyash and pulverized coal obtained in an atmospheric combustion exhaust simulator show that the raw pulverized coal contains large numbers of submicron particles similar to the flyash formed after combustion.

1144 **(UCRL—89262) Fiber optics temperature and pressure probe.** Hirschfeld, T.; Wang, F.; Haugen, G.; Hieftje, G. (Lawrence Livermore National Lab., CA (USA); Indiana Univ., Bloomington (USA)). 29 Sep 1983. Contract W-7405-ENG-48. 6p. (CONF-831025—13). NTIS, PC A02/MF A01. Order Number DE84001785.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The half life, the line width, and the ratio of peak intensities of the R_1 and R_2 ruby lines are only a function of temperature, while the shift in line position and the absolute intensities are functions of both the pressure and temperature. The emission from an optical fiber with a ruby tip encodes both the temperature and pressure of the fiber tip. Both the temperature and the pressure can be deduced by analyzing this spectroscopic information.

1145 **(UCRL—89593) Instrumentation for remote sensing over fiber optics.** Hirschfeld, T.; Haugen, G.; Milanovich, F. (Lawrence Livermore National Lab., CA (USA)). 29 Sep 1983. Contract W-7405-ENG-48. 7p. (CONF-831025—12). NTIS, PC A02/MF A01. Order Number DE84001788.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

We have developed a way to extend the sensing and analytical abilities of the laser-fluorescence spectrometer beyond the physical confines of the laboratory by means of communications-grade optical fibers. These fiber probes are extremely rugged, compared with sensitive laboratory equipment, and also extremely inexpensive. They make it possible to perform sensitive chemical analyses in hostile environments without risking damage to the laser and the spectrometer. We have produced special-purpose optrodes that are sensitive to selected chemicals. With multiplexing, we can scan a number of fibers whose terminals are at widely scattered locations, gathering information in one central instrument without the expense and delay involved in manual sample-gathering. We have begun development of a remote analyzer for monitoring rare-earth-ion migration in a nuclear-waste repository, an environment too hostile for any previous remote sensing device. We are also developing optrodes sensitive to a wide variety of non-chemical stimuli.

1146 **(UCRL—89935) Application of artificial intelligence to triple quadrupole mass spectrometry (TQMS).** Wong, C.M.; Crawford, R.W.; Kunz, J.C.; Kehler, T.P. (Lawrence Livermore National Lab., CA (USA); IntelliGenetics, Inc., Palo Alto, CA (USA)). Oct 1983. Contract W-7405-ENG-48. 9p. (CONF-831015—4). NTIS, PC A02/MF A01. Order Number DE84001779.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A totally computerized triple quadrupole mass spectrometer (TQMS) was designed with the ultimate goal of using the system as a prototype for knowledge-based instrument control, i.e. an intelligent instrument. A tuning procedure for a TQMS is encoded, including heuristics to describe a self-adaptive, feedback control process for real-time optimization or tuning of the data acquisition procedure throughout the entire data collection process. (LEW)

1147 **Dynamic surface-pressure instrumentation for rods in parallel flow.** Mulcahy, T.M.; Lawrence, W.; Wambsganss, M.W. (Argonne National Laboratory, IL). *Experimental Mechanics;* 22: No. 1, 31-36(Jan 1982). (CONF-800575—).

From 4. SESA international congress on experimental mechanics; Boston, MA, USA (25 May 1980).

Methods employed and experience gained in measuring random fluid-boundary-layer pressures on the surface of a small-diameter cylindrical rod subject to dense, nonhomogeneous, turbulent, parallel flow in a relatively noise-contaminated flow loop are described. Emphasis is placed on identification of instrumentation problems, description of transducer construction and mounting; and the pretest calibration required to achieve instrumentation capable of reliable data acquisition.

1148 **Materials science applications of analytical electron microscopy.** Zaluzec, N.J. (Argonne National Laboratory, IL). pp 98-101 of 38th Annual Proceedings of the Electron Microscopy Society of America. Bailey, G.W. (ed.). San Francisco, CA; Electron Microscopy Society of America (1980).

Analytical electron microscopy (AEM) has during the last several years attained great popularity in materials science circles. As the potentials for this field are beginning to become appreciated by those not directly associated with the development of AEM, it is appropriate to illustrate several applications to investigations in metallurgical and ceramic studies. The study of second phase precipitation under equilibrium or non-equilibrium condition is one application in which AEM is proving to be an invaluable tool. Other applications include identification of the composition of non-crystalline phases formed at the grain boundaries of sintered Si_3N_4 compounds and characterization of the omega phase transformation.

4404 Well Logging Instrumentation

1149 **(SAND—83-1799) Downhole data acquisition system.** Weinlein, J.H. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01. Order Number DE84002679.

A limitation of the development model Multi-Element logging probe is that the signal output of the high-purity, cooled, germanium gamma ray detector must be transmitted by coaxial cable uphole for pulse-height analysis of the acquired gamma ray spectra. A downhole pulse-height analyzer eliminates this limitation. Because these are not commercially available, an 8000 channel pulse-height analyzer suitable for eventual incorporation into the Multi-Element logging probe was designed and evaluated. This report provides details of the design of the prototype downhole pulse-height analyzer and the results of its evaluation. Although the performance of the downhole analyzer was quite good, it will not be incorporated into the Multi-Element logging probe because of lack of funding for continuation of the project.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

1150 **(LA-UR—83-2540) Equation of state for the detonation products of several simple explosives.** Shaw, M.S.; Holian, B.L.; Johnson, J.D. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 14p. (CONF-8310148—9). NTIS, PC A02/MF A01. Order Number DE83017266.

From Los Alamos/CEA high explosives and detonation physics conference; Paris, France (3 Oct 1983).

Effective spherical potentials for N_2O_2, NO, CO, and CO_2 are obtained by fitting to various experimental and calculated quantities. An equation of state for mixtures of these molecules is determined by using ideal mixing and the hard-sphere perturbation theory of Ross. Calculations are then compared with Hugoniot data for $N_2 + O_2$ mixtures and overdriven NO detonations with excellent agreement. Also, the detonation velocities of O_3/O_2 mixtures, NO, TNM, and HNB were calculated and were found to be in very good agreement with experiment.

1151 **(LA-UR—83-2541) Effective spherical potentials for detonation products EOS.** Shaw, M.S.; Holian, B.L.; Johnson, J.D. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 12p. (CONF-8310148—7). NTIS, PC A02/MF A01. Order Number DE84001921.

From Los Alamos/CEA high explosives and detonation physics conference; Paris, France (3 Oct 1983).

Using a perturbation expansion, a spherical reference system is found that reproduces the thermodynamics of an anisotropic molecular potential with negligible contribution from higher order terms. For a given anisotropic potential, this effective spherical potential gives pressures and energies good to 1.5% for N_2 in the region of 1.3 g/cm^3 $\leqq$ rho $\leqq$ 2.3 g/cm^3 and 500°K $\leqq$ T $\leqq$ 12,000°K. Preliminary results for CO_2 agree to about 3%. These results help justify the use of empirical spherical potentials for the equation of state of detonation products.

1152 **(UCRL—88965) Relevance of rock mechanics to gun propellants.** Costantino, M. (Lawrence Livermore National Lab., CA (USA)). 21 Oct 1983. Contract W-7405-ENG-48. 29p. (CONF-831192—1). NTIS, PC A03/MF A01. Order Number DE84002010.

From Structures and mechanical behavior subcommittee; Laurel, MD, USA (1 Nov 1983).

Over the past 30 years, earth scientists have made a considerable effort to understand the mechanical response of geologic materials to large static and dynamic stresses. These materials range from loose soils to hard rock, with wide ranges of porosity, composition, particle size, and physical properties. The materials are described with fairly sophisticated equations-of-state that treat elastic and large strain plastic loading of porous, inhomogeneous, anisotropic bodies. Rate and temperature effects also are included, but are not as well understood. Well-developed laboratory methodology exists for studying compaction of porous bodies under hydrostatic loading, failure under shear loading, uniaxial strain loading, fluid flow through connected porosity, pressure dependence of sound speeds and moduli, and fracture of composite assemblies. Elaborate computer codes in one-, two-, and three-dimensions are available to analyze these experiments. Much of the conceptual framework, mathematical formalism, and experimental methods of this mature field applies directly to recent research in packed bed and monolithic grain gun propellants. A review will be given of the isomorphism of several rock mechanics problems to gun propellant problems.

4502 Nuclear

REFER ALSO TO CITATION(S) 1215, 1403

1153 **(AD-A—130292/6) Laboratory investigation of containment in underground nuclear tests. Final report 15 feb 81-15 feb 82.** Cizek, J.C.; Florence, A.L. (SRI International, Menlo Park, CA (USA)). 15 Feb 1982. 102p. NTIS, PC A06/MF A01.

In support of the DNA program for stemming and containment of underground nuclear tests, existing laboratory techniques were further developed and applied to investigate the mechanics of containing gases in cavities formed by underground nuclear explosions. The experimental procedure includes constant flow rate hydrofracture from a central exploded cavity in an externally pressurized grout sphere simulating a geologic material subjected to overburden. The experiments provide hydrofracture records consisting of the time history of cavity pressure as fluid is pumped into the cavity. Hydrofracture records for exploded cavities, which have a surrounding residual stress field, are compared with those for unexploded cavities, which have no residual stress field, to assess the potential benefit to containment of the residual stress field.

1154 **(DOE/NV/00410—78) Operation Praetorian onsite radiological safety report, October 1981-September 1982.** Mullen, O.W.; Eubank, B.F. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Sep 1983. Contract AC08-76NV00410. 126p. NTIS, PC A07/MF A01. Order Number DE84001626.

PRAETORIAN was the name assigned to the series of underground nuclear experiments conducted at the Nevada Test Site from October 1, 1981 through September 30, 1982. Remote radiation measurements were taken during and after each nuclear experiment by a telemetry system. Monitors with portable radiation detection instruments surveyed reentry routes into ground zeros before other planned entries were made. Continuous surveillance was provided while personnel were in radiation areas and appropriate precautions were taken to protect persons from unnecessary exposure to radiation and toxic gases. Protective clothing and equipment were issued as needed. Complete radiological safety and industrial hygiene coverage was provided during drilling and mineback operations. Telemetered and portable radiation detector measurements are listed. Detection instrumentation used is described and specific operational procedures are defined.

1155 **(LA—8552-MS) Microquake activity associated with underground nuclear testing at the Nevada Test Site.** Edwards, C.L.; Harper, M.D.; Weaver, T.A.; Cash, D.J.; Ray, J.M.; Homuth, E.F. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01. Order Number DE84002298.

In the fall of 1976, the Los Alamos Close-In Seismic Network was added to the existing strong motion net deployed around each nuclear test conducted by Los Alamos. Six to ten stations, including both accelerometers and seismometers, are installed within a two-DOB (depth of burial) circle around SGZ (surface ground zero) and operated until the major portion of the microquake activity ceases, usually within 48 hours. Epicentral locations are determined and local magnitudes are calculated from event durations. Four primary conclusions have been reached on the basis of the data analyzed to date: (1) major faults bounding the immediate site of a nuclear test confine the observed microquake activity to the structural block in which the test is conducted; (2) microquake epicenters are generally distributed around the cavity created by the nuclear test with the peak occurrence generally occurring about three cavity radii away from the working point; (3) magnitudes of locatable microquakes apparently distribute randomly over the entire region of activity; and (4) the microquake activity as a function of time appears to be controlled by the collapse phenomenology.

1156 **(UCRL—89770) Nuclear war: preliminary estimates of the climatic effects of a nuclear exchange.** MacCracken, M.C. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 25p. (CONF-8308134—3). NTIS, PC A02/MF A01. Order Number DE84002729.

From 3. international conference on nuclear war; Erice, Italy (16 Aug 1983).

The smoke rising from burning cities, industrial areas, and forests if such areas are attacked as part of a major nuclear exchange is projected to increase the hemispheric average atmospheric burden of highly absorbent carbonaceous material by 100 to 1000 times. As the smoke spreads from these fires, it would prevent sunlight from reaching the surface, leading to a sharp cooling of land areas over a several day period. Within a few weeks, the thick smoke would spread so as to largely cover the mid-latitudes of the Northern Hemisphere, cooling mid-continental smoke-covered areas by, perhaps, a few tens of degrees Celsius. Cooling of near coastal areas would be substantially less, since oceanic heat capacity would help to buffer temperature changes in such regions. The calculations on which these findings are based contain many assumptions, shortcomings and uncertainties that affect many aspects of the estimated response. It seems, nonetheless, quite possible that if a nuclear exchange involves attacks on a very large number of cities and industrial areas, thereby starting fires that generate as much smoke as is suggested by recent studies, substantial cooling could be expected that would last weeks to months over most continental regions of the Northern Hemisphere, but which may have relatively little direct effect on the Southern Hemisphere.

1157 **(UCRL—89907) Global scale deposition of radioactivity from a large scale exchange.** Knox, J.B. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 20p. (CONF-8308134—1). NTIS, PC A02/MF A01. Order Number DE84002007.

From 3. international conference on nuclear war; Erice, Italy (16 Aug 1983).

The global impact of radioactivity pertains to the continental scale and planetary scale deposition of the radioactivity in a delayed mode; it affects all peoples. Global deposition is distinct and separate from close-in fallout. Close-in fallout is delivered in a matter of a few days or less and is much studied in the literature of civilian defense. But much less studied is the matter of global deposition. The global deposition of radioactivity from the reference strategic exchange (5300 MT) leads to an estimated average whole body, total integrated dose of 20 rem for the latitudes of 30 to 50° in the Northern Hemisphere. Hotspots of deposited radioactivity can occur with doses of about 70 rem (winter) to 40 to 110 rem (summer) in regions like Europe, western Asia, western North Pacific, southeastern US, northeastern US, and Canada. The neighboring countries within a few hundred kilometers of areas under strategic nuclear attack can be impacted by the normal (termal close-in) fallout due to gravitational sedimentation with lethal radiation doses to unsheltered populations. In regard to the strategic scenario about 40% of the megatonage is assumed to be in a surface burst mode and the rest in the free air burst mode.

1158 **(UCRL—89956) Tropospheric response to a nuclear exchange.** Penner, J.E. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 15p. (CONF-8308134—2). NTIS, PC A02/MF A01. Order Number DE84002716.

From 3. international conference on nuclear war; Erice, Italy (16 Aug 1983).

The immediate effects of a full-scale nuclear war would be large and severe. The survivors of such a war would have to endure possible changes in the chemical structure of the atmosphere. These changes may come about as a result of changes caused by the nuclear explosions themselves (direct effects) or as a result of changes caused by fires that may start after the explosions (indirect effects). This paper focuses on the expected global-scale changes in the chemical structure of the atmosphere from both direct and indirect effects after a full-scale nuclear exchange. The immediate effects of a nuclear explosion include the creation of a hot mass of air or fireball which rises in the atmosphere to a level that depends on the yield of the explosion. Because the fireball is

hot, it is able to dissociate atmospheric nitrogen, N_2. As the fireball cools, nitrogen atoms recombine with oxygen to form nitrogen oxides, NO and NO_2. In addition, dust and recondensed gases are swept up through the stem of the fireball and deposited at the same level to which the fireball rises. This paper focuses on the response of atmospheric ozone to a nuclear war.

1159 **(UCRL—89957) Nuclear war: short-term chemical and radiative effects of stratospheric injections.** Luther, F.M. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 23p. (CONF-8308134—4). NTIS, PC A02/MF A01. Order Number DE84002717.

From 3. international conference on nuclear war; Erice, Italy (16 Aug 1983).

Earlier investigations of the atmospheric effects of a nuclear war focused primarily on the potential reduction in stratospheric ozone. The numerical models used in those assessments were one-dimensional and calculated the average ozone reduction over the Northern Hemisphere. The results presented here are the first assessment of the potential reduction in total ozone on a subcontinental scale. The purpose is to determine whether regions of large ozone reduction (sometimes called ozone holes) are possible, and to identify the important parameters affecting the magnitude of the ozone reduction and rate of recovery.

1160 **Debate on a comprehensive nuclear weapons test ban Pro.** DeWitt, H.E. (Physics Department, Lawrence Livermore National Laboratory). *Physics Today;* **36**: No. 8, 24(Aug 1983).

A critic on the inside says that a treaty is vital to world security, that it is technically feasible, and that the nuclear weapons laboratories should end their opposition to the idea.

1161 **Debate on a comprehensive nuclear weapons test ban Con.** Barker, R.B. (Lawrence Livermore National Laboratory). *Physics Today;* **36**: No. 8, 25-37(Aug 1983).

In the interest of maintaining a reliable nuclear deterrent capable of surviving Soviet attack, the United States should reexamine its commitment to achieving a comprehensive test ban.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 1155

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 1173, 1718

1162 **(DPST—83-705) Climatology of the Savannah River Plant site.** Hoel, D.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 431p. NTIS, PC A19/MF A01. Order Number DE84001595.

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This document is intended as a reference for those involved in environmental research, and preparing environmental and safety analysis reports about aspects of operations of production and support facilities at the Savannah River Plant (SRP). The information in this document is drawn from appropriate references and from the extensive meteorological data base collected on SRP. This document contains information on the climatological characteristics of the SRP site, as well as information on relative concentrations and deposition for specific radionuclides.

1163 **Compilation of source emissions data and their use in air quality models.** Benkovitz, C.M. (Brookhaven National Laboratory, Upton, NY). pp 62-65 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—). Contract AC02-76CH00016.

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

The Multistate Atmospheric Power Production Pollution Study (MAP3S) is addressed to the physical understanding and the mathematical characterization of wet and dry deposition of atmospheric pollutants. The overall program objective is "to define the relationships between emissions of air pollutants, their deposition and the chemical quality of precipitation." The geographic area of interest includes all of the continental United States and Canada. The compilation of a source emissions inventory is one of the tasks of the Central Data Coordination project of the MAP3S program. Because of the continental nature of the geographic area of interest, compilation of the inventory is based on obtaining pertinent data from other agencies. The National Emissions Data Systems (NEDS) of the Environmental Protection Agency (EPA) provides a centralized repository for emissions data in the U.S.; the Air Pollution Control Directorate of Environment Canada provides an equivalent system for Canadian emissions data. These two agencies have been the main sources of data for the MAP3S emissions inventory. Auxiliary sources of data have been obtained also. Data aquisition, correlation of data sets, timeliness of the data, trajectory models, point sources of SO/sub x/ and NO/sub x/ emissions and data manipulations are discussed.

1164 **Design and preliminary results of the intermediate density precipitation chemistry experiment.** Raynor, G.S. (Brookhaven National Laboratory, Upton, NY). pp 47-49 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—). Contract AC02-76CH00016.

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

The purpose of the Intermediate Density Experiment was to sample up to four main events with fine temporal and moderate spatial resolution, while making maximum use of precipitation the MAP3S program and by other agencies. An aim was to establish a network with 100 to 200 km spacing over most of the northeastern United States so that the probability of several precipitation events occurring over much of the network would be high. In addition to the precipitation sampling network, aircraft measurements, ground-level atmospheric chemistry measurements and operation of a forecast center were part of the experimental plan. Preliminary results are presented.

1165 **Variation of turbulence in a coastal thermal internal boundary layer.** SethuRaman, S.; Raynor, G.S.; Brown, R.M. (Brookhaven National Lab., Upton, NY). pp 157-160 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—). Contract AC02-76CH00016.

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

The purpose of this paper is to present and discuss some observations of the vertical component of turbulence made in a coastal thermal internal boundary layer (TIBL) over Long Island, New York from 1974 to 1978 as part of the Coastal Meteorological Program of the Atmospheric Sciences Division of the Brookhaven National Laboratory. Measurements and analysis are discussed. It is concluded that vertical turbulence measured by a simple sail plane variometer in a thermal internal boundary layer over Long Island with onshore flows indicates the structure to depend significantly on the land-water temperature difference. The structure of vertical turbulence was found to be different for sea breeze flows as compared to gradient winds.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 1, 88, 117, 124, 252, 473, 474, 475, 476, 477, 1047, 1156, 1158, 1159, 1349

1166 **(ANL/RER—83-1) Rush field experiments: growth and initial decay of the mixed layer over an autumn landscape.** Sisterson, D.L.; Wesely, M.L.; Coulter, R.L.; Hart, R.L.; Yamada, T.; Hicks, B.B.; Hess, P.E.; Cook, D.R.; Shannon, J.D.; Zerbe, G.A. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 32p. NTIS, PC A03/MF A01. Order Number DE84001671.

The Rush field experiment, conducted during October 3-14, 1977, provides information on the daytime growth and initial decay of the mixed layer of the lower atmosphere over farmland in southeastern Indiana. Detailed structure of the planetary boundary layer, during conditions typical of autumn, is described by high-resolution miniature-radiosonde, sodar, and lidar data. Sensible heat flux and surface stress data measured over unharvested senescent maize are used to characterize the lower boundary conditions. In addition, ozone and fine submicron particle fluxes are determined in conjunction with a concurrent multiorganizational sulfur box budget study, termed AMBIENS. The methods of observation and data reduction are summarized, and the data obtained are reported in tubular form in a series of appendices. These results may be used to test models of the behavior of the planetary boundary layer, such as variation of the mixed layer heights during the daytime. 34 references, 9 figures, 1 table.

1167 **(BNL—33726) Study of the reaction between N_2O_5 and SO_2.** Tesi, G.; Fuzzi, S.; Senum, G. (State Univ. of New York, Albany (USA); Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 11p. (CONF-8308137—1). NTIS, PC A02/MF A01. Order Number DE84001898.

From CACGP symposium on trospospheric chemistry; Oxford, England (28 Aug 1983).

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During our work we have attempted to determine: where a reaction between gaseous N_2O_5 and SO_2 occurs to yield a solid adduct; the conditions under which this reaction occurs; and whether this reaction could be of significance for atmospheric conditions and processes. From the spectroscopic analysis of the mixture N_2O_5-SO_2 it is not clear whether a gas phase reaction occurs when the reactants are completely dry. However there is an indication that a reaction occurs in the presence of traces of water. The correlation between water concentration and rate of reaction has not been determined; and the nature of the compound formed when water is present has not been determined.

1168 **(BNL—33727) Photothermal detection of NO_2.** Lin, H.B.; Fluckiger, D.U. (Brookhaven National Lab., Upton, NY (USA)). May 1982. Contract AC02-76CH00016. 4p. (CONF-820807—5). NTIS, PC A02/MF A01. Order Number DE84001462.

From 16. annual meeting of the Microbeam Analysis Society; Washington, DC, USA (9 Aug 1982).

An ultrasensitive photothermal technique, called phase fluctuation optical heterodyne (PFLOH) spectroscopy, has been developed for characterization of weakly absorbing species. The technique has been used successfully for the in situ trace detection of atmospheric pollutant gases and aerosols. In this paper is described a new version of a PFLOH apparatus which employs visible laser radiation for sample excitation. Preliminary experiments on NO_2 have achieved sensitivity of one part per million and better. (ACR)

1169 **(BNL—33733) Atmospheric studies pertaining to sulfur in the environment.** Newman, L. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 23p. (CONF-8309150—2). NTIS, PC A02/MF A01. Order Number DE84001455.

From International workshop on stable isotopes in the assessment of natural and anthropogenic sulfur in the environment; Pushchino, USSR (9 Sep 1983).

The atmospheric sulfur cycle and the chemistry pertaining thereto are discussed. Also presented is information on the variation and the use of isotopic variations of sulfur compounds that have been reported upon in the literature. Finally, some consideration is given to the potential for the use of enriched sulfur to study transport and transformation.

1170 **(CONF-830707—6) Methodology for the objective validation of model performance, with an application to atmospheric transport models.** Fields, D.E.; Miller, C.W.; Kurtz, S.E.; Cotter, S.J. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE83015693.

From Summer computer simulation conference; Vancouver, Canada (11 Jul 1983).

Evaluation of model performance may consist of objectively comparing corresponding pairs of observed and predicted values. This defensible provided bias has been identified and removed from the data and that the data are distributed normally or may be transformed so as to be distributed normally. Recent modifications to the TERPED computer code have made this program applicable to the analysis and transformation of small and large data sets. TERPED was used to perform Kolmogorov-Smirnov and graphical analyses of normalized crosswind - integrated ground-level air concentration measurements of zinc sulfide particles released from a height of 111 m at Hanford, Washington as reported by Nickola. Our analysis demonstrates that the data may be considered to be distributed log-normally ($\alpha = 0.014$), but not normally ($\alpha = 0.86$). Simulations of particulate transport used each of three methods of stability determination - (1) vertical temperature gradient, (2) standard deviation of wind direction, and (3) vertical temperature gradient and wind speed - and each of five dispersion parameterizations. Model performance was evaluated by computing the root mean squared difference of log-transformed value pairs, and it was shown that method (2) and Julich (100m) dispersion values gave the best results. For comparison, the models were evaluated using the non-transformed observed and predicted values, and it was shown that application of this inappropriate approach yields ambiguous results that suggest markedly different conclusions.

1171 **(CONF-831047—93) Comparison of observed and predicted normalized particulate air concentrations.** Yildiran, M.; Miller, C.W. (Oak Ridge National Lab., TN (USA); Turkish Electricity Authority, Ankara). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001978.

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

A project is underway to determine the uncertainty associated with the use of mathematical models for the assessment of health impacts associated with radionuclide releases to the environment. The most direct way to determine the uncertainty associated with such models is to compare their predictions with environmental measurements taken under release conditions similar to those assumed by the model, a process commonly referred to as model validation. A volume of data documenting short-term ($\leq$ 30 minutes) atmospheric dispersion experiments carried out at Hanford, Washington under thermally stable conditions is available. This study compares normalized crosswind-integrated ground-level air concentration measurements of zinc sulfide fluorescent particles released from height of 56 m with predicted values made by a Gaussian plume atmospheric dispersion model. 10 references, 1 table.

1172 **(DOE/EP—0018/1) Acid rain information book. Second edition.** (GCA Corp., Bedford, MA (USA). GCA Technology Div.). May 1983. Contract AC01-82EP12079. 411p. NTIS, PC A18/MF A01. Order Number DE84001808.

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Potential consequences of widespread acid precipitation are reviewed through an extensive literature search. Major aspects of the acid rain phenomena are discussed, areas of uncertainty identified, and current research summarized. (PSB)

1173 **(DOE/NBM—4001056) Environmental Research Laboratories Air Turbulence and Diffusion Laboratory, Oak Ridge, Tennessee, 1982 annual report.** (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). 1982. 49p. NTIS, PC A03/MF A01. Order Number DE84001056.

A compilation of abstracts of research conributions for calendar year 1982 are included on: plume transport and diffusion; complex topography; and forest meteorology. (PSB)

1174 **(DP-MS—83-12) Sulfur dioxide, carbon dioxide, and water vapor flux measurements utilizing a microprocessor-controlled data-acquisition system in a pine plantation.** Lorenz, R.; Murphy, C.E. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1983. Contract AC09-76SR00001. 19p. (CONF-8310174—1). NTIS, PC A02/MF A01. Order Number DE84001409.

From Forest environmental measurements conference; Oak Ridge, TN, USA (23 Oct 1983).

A microprocessor-controlled data acquisition system was utilized to determine the flux densities of sulfur dioxide (SO_2), carbon dioxide (CO_2) and water (H_2O) vapor above a young loblolly pine plantation. Electrical noise, data transmission and interfacing problems had to be solved before system startup. Data collection began in June 1982 and continued through May 1983. The average flux densities for SO_2, CO_2 and H_2O vapor for measurement periods scattered throughout the year, for this stand, were found to be .040 $\mu g/m^2/sec$, 1.22 $mg/m^2/$ sec and 96 $mg/m^2/sec$, respectively. The experimental design, system controls, measurement tehcniques, control logic and some results obtained will be discussed. 9 references, 8 figures.

1175 **(GKSS—83/E/13) Neutron activitation analysis of an air-dust sample using a high-flux 14 Mev neutron generator.** Bahal, B.M.; Pepelnik, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83751342.

The 14 MeV neutron activation analysis technique is illustrated for multielement analysis of a Milanese air-dust sample. The neutron generator and electronic system, the efficiency and flux calibration, the γ-ray background, the sample preparation and the peak analysis used are described. After careful corrections of all possible interferences and error calculations, the results of 24 elemental concentrations are compared with those of other analytical techniques in the scope of an interlaboratory test.

1176 **(IS—4831) Identification and characterization of pollutants. Quarterly report, July 1-September 30, 1982.** (Ames Lab., IA (USA)). Feb 1983. Contract W-7405-ENG-82. 139p. NTIS, PC A07/MF A01. Order Number DE84001676.

Progress is reported in the following research areas: (1) health and environmental impact of waste and biomass to energy processes-organ culture studies; (2) characterization of organic pollutants; (3) environmental effects of using municipal solid wastes as a supplementary fuel; (4) microbiological air quality of the Ames Municipal Solid Waste Recovery System; (5) solid waste to methane study; (6) high resolution luminescence spectroscopy; (7) biochemical and personnel monitors; and (8) risk assessment of municipal wastes as a supplemental fuel. (ACR)

1177 **(IS—4840) Identification and characterization of pollutants. Quarterly report, October 1-December 31, 1982.** (Ames Lab., IA (USA)). Jun 1983. Contract W-7405-ENG-82. 21p. NTIS, PC A02/MF A01. Order Number DE84001795.

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Progress is reported in the following research areas: (1) high resolution, high sensitivity luminescence and other spectroscopic techniques; and (2) advanced methodologies for measurement of toxic effluents from energy processes. (ACR)

1178 **(IS—4841) Identification and characterization of pollutants. Quarterly report, January 1-March 31, 1983.** (Ames Lab., IA (USA)). Jun 1983. Contract W-7405-ENG-82. 22p. NTIS, PC A02/MF A01. Order Number DE84001550.

Progress is reported in the following research areas: (1) high resolution, high sensitivity luminescence and other spectroscopic techniques, and (2) advanced methodologies for measurement of toxic effluents from energy processes. (ACR)

1179 **(LBL—15298) Energy and Environment Division, Environmental Research Program, annual report FY 1982.** (Lawrence Berkeley Lab., CA (USA)). Jul 1983. Contract AC03-76SF00098. 115p. NTIS, PC A06/MF A01. Order Number DE84001923.

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The primary concern of the Environmental Research Program is the understanding of pollutant formation, transport, and transformation and the impacts of pollutants on the environment. These impacts include global, regional, and local effects on the atmosphere and hydrosphere, and on certain aspects of human health. This multidisciplinary research program includes fundamental and applied research in physics, chemistry, and biology, as well as research on the development of advanced methods of measurement and analysis. During FY 1982, research was concentrated on atmospheric physics and chemistry, applied physics and laser spectroscopy, combustion research, environmental effects of oil shale processing, fresh-water ecology and acid precipitation, trace element analysis for the investigation of present and historical environmental impacts, and a continuing survey of instrumentation for environmental monitoring. Separate abstracts have been prepared for each research task for inclusion in the Energy Data Base.

1180 (LBL—15298, pp 4.3-4.5) **Evidence for primary oxidants of SO_2.** Benner, W.H.; McKinney, P.M.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

A number of pathways by which SO_2 is oxidized in aqueous atmospheric droplets have recently been compared. Oxidation occurs either by reaction with gas-phase oxidants like O_3 and H_2O_2 after they have been absorbed into the droplets, or catalytically with trace metals or soot particles. The gas-phase oxidants have been assumed to originate solely from secondary photochemical reactions in the atmosphere. However, we have recently found evidence for combustion-generated (i.e., primary) oxidants of SO_2. In this article, we describe our preliminary observations. When SO_2 is introduced into the air flow in the chimney at a rate that maintains its concentration at $\sim$ 1 ppM, an instantaneous decrease in this concentration is observed when a fuel such as propane (50 ml/min) is burned in the torch. This can be explained by a gas-phase reaction occurring between SO_2 and combustion gases, a suggestion that was supported by additional experiments. Preliminary experiments were performed to determine if automobiles are sources of primary oxidants. Results indicate that automobiles could be a significant source of primary oxidants. Plans are underway to speciate the various oxidants that can be released by combustion sources. Once this is done, a kinetic study of the SO_2 + oxidant reaction will be started. The ultimate goal is to develop a reaction rate expression.

1181 (LBL—15298, pp 4.5-4.7) **S(IV) oxidation by ambient particulate matter.** Benner, W.H.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

This investigation of SO_2 oxidation in the atmosphere has focused on heterogeneous oxidation pathways. We have found that aqueous suspensions of activated carbons (used as model systems to simulate droplets with particulate carbon) and aqueous suspensions of traffic-generated combustion particles collected in a highway tunnel oxidize S(IV) to sulfate. These results suggest that ambient soot particles, and perhaps other ambient particles, can oxidize SO_2 to sulfate. This article describes our current efforts to determine the role of particulate matter in oxidizing SO_2 to sulfate.

1182 (LBL—15298, pp 4.7-4.10) **Real-time measurement of the absorption coefficient of aerosol particles.** Hansen, A.D.A.; Rosen, H.J.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Recent studies have shown that large concentrations of graphitic carbon particles are found in the atmosphere in both urban and remote locations. These particles are produced in combustion and have a large optical absorption cross section, on the order of 10 m^2/g. Their presence affects radiation transfer through the atmosphere, causing visibility degradation and possible changes in the regional or global radiation balance. The size of these effects depends critically on both the concentration of the particles and their single-scattering albedo, which is determined by the relative magnitude of the scattering and absorption coefficients. The scattering coefficient is easily measured by the nephelometer. However, measurements of the absorption coefficient of an ambient aerosol are difficult, mainly because of the small magnitude of this coefficient. In this article, we outline the development of an instrument that measures the attenuation of a light beam transmitted through particles that are being continuously collected on a suitable filter. We have named this instrument the aethalometer. Calibration and field trials are described.

1183 (LBL—15298, pp 4.10-4.13) **Relationship between optical attenuation and black carbon concentration for carbonaceous particles.** Gundel, L.A.; Dod, R.L.; Rosen, H.J.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Aerosol particulate material from ambient air and combustion sources usually appears black when collected on filters because of the presence of light-absorbing black carbon. In the atmosphere, this light absorption can degrade visibility and perturb the tropospheric energy balance. Light absorption provides the basis for a fast and nondestructive method for determining concentrations of black carbon on filter samples - the LBL laser transmission technique. This measures the attenuation (ATN) of visible light as it passes through the filter. When the relationship between ATN and black carbon concentration ([BC]) is known, a good estimate of [BC] can be derived from the simple ATN measurements. This application relies on the assumption of similar optical properties for both source and ambient particles. In this study, we measured [BC] and ATN simultaneously for a large group of source and ambient filter samples. The results were used to calibrate the LBL laser transmission technique and to provide a value for the specific attenuation.

1184 (LBL—15298, pp 4.13-4.15) **Graphitic-carbon-to-lead ratio as a tracer for sources of the arctic aerosol.** Rosen, H.J.; Hansen, A.D.A.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

There is considerable indirect evidence that a major part of the Arctic aerosol is produced from combustion processes. However, the strongest and most direct substantiation of this inference has been provided by the identification of large concentrations of graphitic carbon in the Arctic atmosphere. These graphitic species, which have a structure similar to carbon black, can be produced only by combustion processes. The concentration of these particles at Barrow during the winter and spring approaches those found in urban areas. Associated with these graphitic species are large optical absorption coefficients ($\sim 10\ m^2\ g^{-1}$), which could produce a significant perturbation of the heat balance over the Arctic. Preliminary model calculations indicate that present springtime concentrations of graphitic particles could increase the atmospheric heating rate by an amount comparable to that expected from a doubling of the CO_2 concentration. The sources of the Arctic aerosol are unknown at present. Part of the aerosol may come from local Alaskan sources, but there is considerable evidence that a major fraction is due to long-range transport from other industrialized regions, with Eurasia suggested as a major source area. Use of the ratio of graphitic carbon to lead as a tracer for the sources of the arctic aerosol is described.

1185 (LBL—15298, pp 4.16-4.18) **Oxygen content of ambient particulate matter.** Benner, W.H.; Chuang, C.; Hansen, A.D.A.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

The light-scattering, haze-forming particles of the troposphere can come from primary sources like combustion engines and wind-blown dust or from secondary sources, i.e., chemical reactions that transform gases into particles. Oxygen in the particles can be grouped into several fractions: organic oxygen, carbonates, nitrates, sulfates, silicates, and metal oxides. In general, primary particulate matter contains carbonates, silicates, and metal oxides (from resuspended soil and fly ash) and is likely to contain organic oxygen from incompletely burned fuels. Secondary particulate matter contains sulfates, nitrates, and presumably organic oxygen from photochemically initiated reactions. We are attempting to determine the relative importance of the primary and secondary origins of oxygenated-organic particulate matter; this article describes our initial efforts.

1186 (LBL—15298, pp 4.18-4.23) **Qualitative and quantitative aspects of evolved gas analysis.** Gundel, L.A.; Dod, R.L.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

The thermal analytical method of evolved gas analysis (EGA) is described and compared with thermogravimetric analysis. EGA determines the rate of evolution of gaseous species from the sample. In EGA, a sample is gradually heated in a stream of oxygen or nitrogen, and the evolved gases are measured by one or more gas-specific detectors as a function of the sample temperature. For characterizing carbon- and nitrogen-containing materials, it is convenient to use oxygen as the carrier gas with simultaneous detection of CO_2 and NO/sub x/. EGA requires no special sample preparation or preseparation and is therefore applicable to both soluble and insoluble sample components. This feature, combined with the high sensitivity of the method, was found to be especially useful in analysis of environmental samples. Examples obtained from analysis of several inorganic nitrogen compounds and several organic compounds are included.

1187 (LBL—15298, pp 4.24-4.26) **Determination of non-ammonium, non-nitrate nitrogen in atmospheric aerosol particles.** Dod, R.L.; Gundel, L.A.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

The method of evolved gas analysis (EGA) is applied to the determination of non-ammonium, non-nitrate nitrogen (N/sub x/) in atmospheric aerosol particles collected on filters. To explore this possibility, an ambient sample (collected in Ljubljana, Yugoslavia) was chosen because its ESCA spectrum clearly indicated the presence of both NH_4^+ and N/sub x/ with the ratio of NH_4^+ to N/sub x/ nitrogen $\simeq$ 1.4. The nitrogen ESCA spectrum of the sample is shown. (DMC)

1188 (LBL—15298, pp 4.26-4.27) **Investigation of the relationship of particulate nitrogen and sulfate.** Dod, R.L.; Benner, W.H.; Novakov, T. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

While it is generally known that water extraction of ambient aerosol particulate material usually produces a solution containing ammonium, sulfate, and nitrate ions, what compounds existed in the particles before extraction remains uncertain. We have postulated that, in addition to the simple compounds of these ions, nitrogenous functional groups on the organic and/or elemental carbon present in the particles may act as cationic sites to which sulfate and nitrate are bonded. To study this postulated relationship among sulfur, nitrogen, and carbon, we are using a variety of techniques with complementary strengths that help to overcome the limitations of each one alone. X-ray photoelectron spectroscopy (ESCA) evolved gas analysis (combustion thermal analysis), and ion chromatography

(IC) were used in the study. The results indicate that the observed similarity to ammonium sulfate in the NO/sub x/ thermograms of these samples, when considered with the similarity between the concentration of NH_4^+ determined by IC and the concentration of total reduced nitrogen determined by ESCA, provides substantial evidence for the formation of ionic compounds between sulfate and organic nitrogenous functional groups.

1189 (LBL—15298, pp 4.97-4.99) **Lake ecotoxicpology research.** Harte, J.; Levy, D.J.; Lockett, G.P.; Oldfather, J.M.; Rees, J.T.; Saegebarth, E.I.; Schneider, R.A. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Topics include: realism and replicability of lentic microcosms as a function of water agitation; and acid precipitation and surface-water vulnerability on the Western slope of the high Colorado Rockies.

1190 (LBL—15298, pp 4.105-4.109) **Trace element analysis.** Quinby-Hunt, M.; McLaughlin, R.; Quintanilha, A.; Morton, G.; Case, C. Jul 1983. NTIS, PC A06/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, Environmental Research Program, annual report FY 1982.

Topics discussed are: survey of instrumentation for enviornmental monitoring, and current status of the impact theory of mass extinction.

1191 **(LBL—15839) Continuous measurements of radon entry in a single-family house.** Grimsrud, D.T.; Nazaroff, W.W.; Revzan, K.L.; Nero, A.V. (Lawrence Berkeley Lab., CA (USA)). Mar 1983. Contract AC03-76SF00098. 21p. (CONF-830617—14). NTIS, PC A02/MF A01. Order Number DE84001820.

From 76. annual meeting of the Air Pollution Control Association; Atlanta, GA, USA (19 Jun 1983).

The body of information in this paper is directed to researchers and others interested in the field of indoor air quality. It is a progress report that describes detailed measurements during a six-month period of radon concentration, ventilation rate, and other environmental parameters that affect radon entry in a single-family house. Average radon concentrations in the house varied between 0.1 and 18.4 pCi/1 during this period; the mean value observed was 3.1 pCi/1. Ventilation rates ranged from 0.03 to 1.00 ach; the mean value was 0.25 ach. The data show that the radon source strength varied substantially during the measurements; we continue to examine the environmental parameters measured to obtain a better understanding of the processes that influence radon entry into the house. The major radon entry site in this structure appears to be the basement sump. A portion of the time variation in the entry rate can be associated with changes in the water level in the sump that couples and decouples the sump with an exterior drain tile system.

1192 **(LBL—16104) Non-ammonium reduced nitrogen species in atmospheric aerosol particles.** Dod, R.L.; Gundel, L.A.; Benner, W.H.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 9p. (CONF-8309166—4). NTIS, PC A02/MF A01. Order Number DE84000730.

From 2. international conference on carbonaceous particles in the atmosphere; Linz, Austria (11 Sep 1983).

The traditional belief that ambient aerosol particles contain nitrogen predominantly in the form of inorganic ionic species such as NH_4^+ and NO_3^- was challenged about 10 years ago by results from x-ray photoelectron spectroscopic analysis (ESCA) of California aerosol particles. A significant fraction (~ 50%) of the reduced nitrogen was observed to have an oxidation state more reduced than ammonium, characteristic of organic nitrogen species. We have used a recently developed thermal evolved gas analysis method (NO/sub x/) in conjunction with ESCA to confirm the existence of these species in aerosol particles collected in both the United States and Europe. The agreement of EGA and ESCA analyses indicates that these species are found not only on the surface but also throughout the particles. 9 references, 6 figures.

1193 **(LBL—16105) Relationship between optical attenuation and black carbon concentration for ambient and source particles.** Gundel, L.A.; Dod, R.L.; Rosen, H.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 9p. (CONF-8309166—3). NTIS, PC A02/MF A01. Order Number DE84001091.

From 2. international conference on carbonaceous particles in the atmosphere; Linz, Austria (11 Sep 1983).

Light absorption provides the basis for a fast and nondestructive method for determining concentrations of black carbon (BC). The laser transmission technique measures the attenuation (ATN) of visible light as it passes through filter samples. We have measured [BC] and ATN simultaneously for a large number of solvent-extracted source and ambient particle samples, using temperature-programmed evolved gas analysis with continuous light attenuation measurement. For all data with ATN $\leqq$ 200, ATN is directly proportional to [BC], with the proportionality constant = 25.4 +- 1.7 $cm^2\ \mu g^{-1}$. Because the relationship between ATN and [BC] does not depend on the origin of the carbonaceous particles, measurement of ATN alone can provide a good estimate of the black carbon concentration. 12 references.

1194 **(LBL—16107) Role of graphitic carbon particles in radiative transfer in the arctic haze.** Rosen, H.; Hansen, A.D.A.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 12p. (CONF-8309166—5). NTIS, PC A02/MF A01. Order Number DE84001078.

From 2. international conference on carbonaceous particles in the atmosphere; Linz, Austria (11 Sep 1983).

Large concentrations of combustion-generated graphitic carbon particles have been identified at ground level and at altitude in the Arctic atmosphere. Concentrations of these particles during certain times of year and at certain altitudes are comparable to those in urban centers in the United States. These graphitic particles, which have a structure similar to carbon black, have been identified on a molecular level using Raman spectroscopy at sites in the Alaskan, Canadian, and Norwegian Arctic. The black particles are very effective absorbers of solar radiation and can lead to significant heating effects, depending primarily on their distribution in time and space. Recent measurements from an airplane indicate that high concentrations of graphitic particles occur throughout the Arctic troposphere, and at certain altitudes the concentrations can be significantly higher than at ground level. The implications of these results to radiative transfer will be discussed. 23 references.

1195 **(LBL—16108) Role of soot and primary oxidants in atmospheric chemistry.** Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 13p. (CONF-8309166—2). NTIS, PC A02/MF A01. Order Number DE84000899.

From 2. international conference on carbonaceous particles in the atmosphere; Linz, Austria (11 Sep 1983).

This paper discusses the role of soot in atmospheric sulfur chemistry. A methodology for estimating the primary and secondary particulate carbon concentrations is outlined. The relationship between ambient SO_2, sulfate, and primary carbon is examined; and certain regularities in their behavior are defined. An explanation of these regularities is proposed, based on a mechanism involving oxygen chemisorbed on combustion-generated carbon particles and its subsequent reaction with aqueous sulfite. 23 references, 6 figures.

1196 **(LBL—16473) Raman study of graphitic-carbon concentrations in the western Arctic.** Rosen, H.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 10p. NTIS, PC A02/MF A01. Order Number DE84001090.

Direct substantiation of combustion-generated particles in the Arctic atmosphere has been provided by the identification of large concentrations of graphitic carbon particles at the NOAA-GMCC observatory near Barrow, Alaska. An extension of these studies of carbon particles to the Canadian and the Norwegian arctic is reported. These studies, using the Raman scattering technique, identify substantial concentrations of graphitic carbon particles at ground-level stations throughout the western Arctic. These results show that the large concentrations of graphitic particles

found at Barrow are not a local phenomenon but are characteristic of ground-level stations throughout the western Arctic. (ACR)

1197 **Pollutant emissions from portable kerosene-fired space heaters.** Traynor, G.W.; Allen, J.R.; Apte, M.G.; Girman, J.R.; Hollowell, C.D. (Lawrence Berkeley Laboratory, CA). *Environmental Science and Technology;* 17: No. 6, 369-371(Jun 1983). Contract AC03-76SF00098.

Indoor use of unvented combustion appliances is known to cause an increase in indoor air pollutants. We conducted laboratory tests on two radiant and two convective portable kerosene-fired space heaters to identify the pollutants they emit and to determine their emission rates. Results show that carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, and formaldehyde were emitted by both types of heaters and that the radiant heaters and one of the convective heaters also emitted trace amounts of fine particles. When such heaters are operated for 1 h in a 27-m^3 chamber with 0.4 air changes per hour, the resultant CO_2 concentrations are well above the U.S. occupational standard, and NO_2 concentrations are well above California's short-term outdoor standard.

1198 **Acid rain deposition patterns in the continental United States.** Wisniewski, J. (Flow General Inc., McLean, VA); Keitz, E.L. *Water, Air, and Soil Pollution;* 19: No. 4, 327-339(May 1983).

Acid rain has become a major environmental concern, the current extent of which is illustrated in this paper. Maps of both pH and H^+ deposition in precipitation have been developed for the continental United States by analyzing laboratory pH data from mine precipitation chemistry networks and two single stations spread across the continental United States and southern Canada during the late 1970's. Average laboratory pH values were obtained or calculated for approximately 100 stations, and isopleths of weighted mean pH and mean annual H^+ deposition in precipitation were drawn. Results of this analysis show that in spite of a wide variety of collection methods and sampling intervals, there is remarkable uniformity in the average pH among the various stations. The northeastern United States continues to exhibit the most acidic precipitation, with remaining portions of the eastern United States, states along the western coastline and a pocket in central Colorado also experiencing acid precipitation.

1199 **The problem of aliasing in inferring long-range air pollution transport to Mauna Loa, Hawaii.** Darzi, M.; Winchester, J.W. (Florida State University, Tallahassee). *Water, Air, and Soil Pollution;* 19: No. 4, 407-409(May 1983).

Choice of sampling strategy or criteria for selection of aerosol concentration data from a time series record can lead to errors in estimating periodic regularities because of aliasing. By means of an example from Mauna Loa Observatory during spring dust transport from Asia, it is shown that the detection of possible transport of pollution across the Pacific to Hawaii could be missed through inadvertent aliasing errors.

1200 **Origin and growth mechanisms of the sulfated crusts on urban limestone.** Camuffo, D. (Istituto di Chimica e Tecnologia dei Radioelementi-CNR, Padova, Italy); Monte, M.D.; Sabbioni, C. *Water, Air, and Soil Pollution;* 19: No. 4, 351-359(May 1983).

Building stone surfaces exposed to the urban environment are subjected to rapid and differentiated deterioration, due to various chemical and physical attacks. Apart from a chemical deterioration below the sulfated crusts, which mainly grow outwards at the unaltered gypsum/carbonatic rock interface, another physical deterioration was observed. The latter is, at times, even more important than the rapid chemical attack typical of the zones which are subjected to heavy washing by rainwater. The formation and growth of three different kinds of deterioration layers are discussed with reference to the main kinds of deterioration characterized by white, grey and black external appearance. Analyses of airborne particulate matter and of deterioration layers of urban monuments led to the conclusion that not all the gypsum of crusts which can be observed on marble monuments is derived from the transformation of the underlying rock, but it is also partially transported by aerosols.

1201 **Effect of sample conditioning and chamber loading on rate of formaldehyde release from wood products in a desiccator test.** Griffis, L.C.; Pickrell, J.A. (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM). *Environment International;* 9: No. 1, 3-7(1983). Contract AC04-76EV01013.

Several variables may influence the observed rate of formaldehyde (CH_2O) offgassing from wood products in a small static test chamber. We studied the effect of sample conditioning at ~ 100% relative humidity and chamber loading (sample size) on CH_2O release rate from particle board (PB) and plywood (PW). Samples of PB and PW were placed in glass desiccators with reservoirs of water at a loading of 21 m^2/m^3 (sample surface area per chamber volume). The rate of CH_2O offgassing from the PB did not change over several weeks under these conditions (0.24 $\mu g/cm^2/day$), but the overall release rate from the PW decreased after 8 days. In another experiment, the loading of the desiccator had a major effect on the rate of CH_2O offgassing from PB over a loading range of 1 to 42 m^2/m^3. The same phenomenon was observed with different loadings of PW. The inverse of the observed release rate varied linearly with the chamber loading of PB or PW. At a loading which may be encountered in a house (0.25 m^2/m^3), the release rate coefficient for PB calculated from the above inverse relation was 22-fold higher than that measured at a more conventional test load of 21 m^2/m^3. These results indicate tht great care should be exercised when using desiccator tests for assessing and comparing the potential strength of materials as sources of CH_2O in the indoor environment.

1202 **Formaldehyde release from simulated wall panels insulated with urea-formaldehyde foam insulation.** Hawthorne, A.R.; Gammage, R.B. (Oak Ridge National Lab., TN). *Journal of the Air Pollution Control Association;* 32: No. 11, 1126-1131(Nov 1982). Contract W-7405-ENG-26.

An important potential source of formaldehyde in the home is urea-formaldhyde foam insulation (UFFI). This study measures the long-term release of formaldehyde through the interior wall of test panels foamed with commercial urea-formaldehyde insulation. The measurements, made approximately 16 mo after initial foaming, were conducted under both static and dynamic air conditions with air flow selected to simulate a typical air exchange found in houses. Estimated room concentrations based on a simple model of uniform mixing within a room and measured emission rates are presented. Measurements of formaldehyde in the air from within the UFFI cavities are also reported.

1203 **Particle size sensitivity of two aerosol mass concentration monitors.** Fairchild, C.I. (Los Alamos National Laboratory, New Mexico). *American Industrial Hygiene Association Journal;* 43: No. 9, 712-715(Sep 1982). Contract W-7405-ENG-36.

Particle size sensitivity was determined for two fast response aerosol mass monitors, the GCA RDM-101 and -301. Readings from the mass monitors were compared to gravimetric measurements of concentrations of known size monodisperse and polydisperse aerosols. An effective measurement aerodynamic diameter (EMAD), defined as the particle aerodynamic diameter at which the monitor indicated 50% of the gravimetrically measured concentration, was determined for each monitor. The EMAD was 1.3 +/- 0.1 μ for both monitors. The effect of particle size sensitivity on the estimation of respirable dust concentration is discussed.

1204 **Air infiltration measurements in a home using a convenient perfluorocarbon tracer technique.** Dietz, R.N.; Cote, E.A. (Brookhaven National Laboratory, Upton, NY). *Environment International;* 8: No. 1-6, 419-433(1982). (CONF-811048—).

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Using miniature perfluorocarbon tracer (PFT) sources and miniature passive samplers, both about the size of a cigarette, tests conducted in the laboratory and in a typical home successfully demonstrated the utility of the PFT kit as a means for implementing wide-scale infiltration measurements in homes. The PFT diffusion plug source, and elastomer containing a dissolved perfluorocar-

bon compound, was shown to emit vapors at the rate of about 0.1 to 5 nL/min, providing steady-state concentrations in a home of about 1 to 10 pL/L, i.e., parts per trillion by volume, when one source is deployed for each 300-500 ft^2 (28-46 m^2) of living space. The emission rate from the diffusion source was predictable, but its dependence on both temperature and time suggested the development of alternative approaches. One such alternative, a liquid PFT permeation source, had emission rates which could be tailored over the range 10-20 nL/min, were independent of age for as long as the liquid remained (≈5 yr), and had significantly lower temperature dependence. A number of passive adsorption tube samplers performed reproducibly and identically (to within +/- 2%-3%) in laboratory tests. Together with a programmable tracer sampler, the miniature diffusion sources and samplers were deployed, three on each level of a two-story house. Multiple location sampling, as well as sampling in rooms with and without a miniature source, demonstrated that even in a house without forced-air circulation, a well-mixed modeling approach is justified. Analyses of the tracer samplers were performed back in the laboratory with an automatic electron-capture gas-chromatography system.

1205 **Low-infiltration housing in Rochester, New York: a study of air-exchange rates and indoor air quality.** Offerman, F.J. (Lawrence Berkeley Lab., CA); Hollowell, C.D.; Nazaroff, W.W.; Roseme, G.D.; Rizzuto, J.R. *Environment International;* 8: No. 1-6, 435-445(1982). (CONF-811048—). Contract AC03-76SF00098.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

A sample of 58 occupied homes in Rochester, NY, most of which incorporated special builder-designed weatherization components, were studied to assess (1) the effectiveness of construction techniques designed to reduce air leakage; (2) the indoor air quality and air-exchange rates in selected airtight houses, and (3) the impact on indoor air quality of mechanical ventilation systems employing air-to-air heat exchangers. The "specific leakage area" was measured in each house using the fan pressurization technique. Houses built with polyethylene vapor barriers and joint-sealing were as a group 50% tighter than a similar group of houses without such components. Mechanical ventilation systems with air-to-air heat exchangers were installed in nine relatively airtight houses, some of which had gas stoves and/or tobacco smoking occupants. Air-exchange rates and indoor concentrations of radon (Rn), formaldehyde (HCHO), nitrogen dioxide (NO_2), and humidity were measured in each house for 1-week periods with and without mechanical ventiltion. More detailed measurements, including concentrations of carbon monoxide and inhalable particulates, were made in two of these houses by a mobile laboratory. In all nine houses, air-exchange rates were relativley low (0.2-0.5 ach) without mechanical ventilation, and yet indoor concentrations of Rn, HCHO, and NO_2 were below existing guidelines. Mechanical ventilation systems were effective in further reducing indoor contaminant concentrations. We conclude that when contaminant source strengths are low, acceptable indoor air quality can be compatible with low air-exchange rates.

1206 **The effects of ventilation on residential air pollution due to emissions from a gas-fired range.** Traynor, G.W.; Apte, M.G.; Dillworth, J.F.; Hollowell, C.D.; Sterling, E.M. (Lawrence Berkeley Laboratory, CA). *Environment International;* 8: No. 1-6, 447-452(1982). (CONF-811048—). Contract AC03-76SF00098.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The use of indoor combustion appliances can cause an increase in the levels of many different pollutants. The work presented here shows the usefulness of a model for extrapolating environmental chamber results on pollutant concentrations in actual residences. In addition, the effects of infiltration, whole-house ventilation, and spot ventilation on pollutant levels are investigated. The results show that a range hood is the most effective means of removing pollutants emitted from a gas-fired range; removal rates varied from 60% to 87%.

1207 **Indoor air quality modeling: compartmental approach with reactive chemistry.** Ozkaynak, H. (Harvard Univ., Cambridge, MA); Ryan, P.B.; Allen, G.A.; Turner, W.A. *Environment International;* 8: No. 1-6, 461-471(1982). (CONF-811048—). Contract AC02-81EV10731.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Data on indoor/outdoor pollutant and tracer concentrations were collected during different periods in 1981 at a residence in Newton, MA. Special studies within the kitchen were conducted to determine the vertical and horizontal variability of pollutant and tracer gas concentrations. A reactive chemistry model incorporating simplified NO/sub x/ chemistry was developed to simulate pollutant concentrations indoors. Multicompartmental mathematical modeling tools were also developed and tested to estimate efficiently the effective, emission, ventilation, and removal rates, as well as the intercompartmental pollutant exchange coefficients. Model studies utilizing two- and three-compartment systems and tracer measurements proved that the dynamics of pollutant mixing inside a kitchen is not only complex but may be quite important in controlling spatial and temporal variability of reactive species. Further monitoring and modeling studies to investigate the critical aspects of the short-term dynamics of the reactive pollutants inside homes with gas cooking stoves are recommended.

1208 **An analysis of spatial variability of the dominant ions in precipitation in the eastern United States.** Wilson, J.W. (U.S. Military Academy, West Point, NY); Mohnen, V.A. *Water, Air, and Soil Pollution;* 18: 199-213(1982). Contract AC02-76EV02986.

Data of the Multistate Atmospheric Power Production Study (MAP3S) and the National Atmospheric Deposition Program (NADP) were utilized to develop wet deposition spatial distribution patterns for the eastern United States for 1979. The ions of SO_4^{--}, NO_3^{--}, H^+, and NH_4^+ were selected for study since they are the most prominent ones found in precipitation. Total wet deposition for 1979 was normalized to one centimeter of precipitation and objectively analyzed using the Synagraphic Mapping System (SYMAP) technique. Gradients of SO_4^{--} and NO_3^- were found to be essentially uniform, both to the east and west of the major pollution regions. An increased gradient in normalized deposition of SO_4^{--}, NO_3^-, and H^+ was found in the Appalachian Mountain region. Estimates of total wet deposition were obtained by using the normalized deposition values in conjunction with precipitation as reported by the National Climatic Center. SYMAP analyses of the estimated total wet deposition were localized in nature due to precipitation variations between sites.

1209 **On the use of the pseudo-spectral technique in air-pollution modeling.** Patrinos, A.A.N.; Leach, M.J. (Brookhaven National Laboratory, Upton, NY). pp 98-101 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—). Contract AC02-76CH00016.

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

The numerical simulation of time dependent flows in the atmosphere is of paramount importance in studies of air pollution. The modeling of dispersion, reaction, and deposition of the various pollutant species is performed along similar lines. Two types of models exist, the Lagrangian type which refers to a coordinate system fixed in relation to the mean wind, and the Eulerian type which uses a coodinate system fixed in space. The Eulerian models are, generally, becoming more popular because of their ability to simulate complex flows and to incorporate a large number of sources. The problems associated with the accuracy and stability of the various numerical schemes used in Eulerian models to approximate the advection-diffusion terms occupy a significant research area in applied mathematics. The pseudo-spectral method for the solution of the dispersion equations is a relatively recent development which offers considerable advantages over the more established finite difference schemes. The main advantage of this method is the superior accuracy in the representation of the spatial derivatives; the only limit is the extent to which a distribution can be represented on a finite set of meshpoints. The pseudo-spectral method is based on the expansion of the dependent variables in terms of

orthogonal functions, with the use of finite Fourier series expansions becoming increasingly frequent due to the development of the fast Fourier transform (FFT). This paper addresses two serious drawbacks of the pseudo-spectral method and offers suggestions for improvement.

1210 **Comparison of modeling techniques in mountain valleys.** Baskett, R.L.; Asoian, M.J. (Camp Dresser and McKee, Inc., Wheat Ridge, CO). pp 175-177 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—).

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

This paper briefly discusses the recent experience of the authors with the use of three currently available modeling methods for mountain valleys--Gaussian, box, and numerical. It appears very difficult to apply the steady-state Gaussian VALLEY plume model for both low level and elevated releases in mountain valleys. Enhancement of vertical dispersion due to the increased roughness is not predicted by the standard dispersion parameters in the model. In addition, VALLEY's inability to model the turning of the wind due to channeling and its oversensitivy to elevated terrain makes this technique inadequate for such applications. Box modeling seems to provide a conservative estimate of impacts from low level releases in the valley bottom, but underpredicts concentrations due to elevated releases. Numerical models, such as IMPACT, which provide realistic, three-dimensional flow and diffusivity fields, give the most reasonable estimates of concentrations in mountain valleys.

1211 **Regional transport of ozone.** Clarke, J.F.; Ching, J.K.S.; Brown, R.M.; Westberg, H.; White, J.H. (Environmental Protection Agency, Research Triangle Park, NC). pp 1-4 of 3rd joint conference on application of air pollution meteorology. Boston, MA; American Meterological Society (1982). (CONF-820101—).

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

Recognizing the importance of the transport of ozone in developing control strategies for downwind urban areas, EPA developed a regional scale photochemical air quality simulation model. Because of the complexities of the simulations of both meterological dynamics and chemical kinetics, a detailed three dimensional network of pollution and meteorological data was needed to evaluate and validate the model. To collect these data EPA conducted the Northeast Regional Oxidants Studies (NEROS) during the summers of 1979 (NEROS I) and 1980 (NEROS II). This paper describes the NEROS I regional model field validation program. The analysis suggests that regional transport of ozone at high concentrations may occur during nocturnal hours. The source of the ozone is precursors emitted primarily from urban areas. Urban plumes may maintain some integrity out to 12 hours and possibly 24 to 30 hours but eventually merge and blend with the air mass burden. It is necessary to study the time dependent physical and chemical processes of the urban plume in greater detail for modeling regional transport of pollutants.

1212 **Intercomparison of MAP3S models of long-range transport and deposition.** Shannon, J.D.; Kleinman, L.; Benkovitz, C.; Berkowitz, C. (Argonne National Laboratory, IL). pp 29-32 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—).

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

The Multistate Atmospheric Power Production Pollution Study (MAP3S), begun in the mid-1970's under Department of Energy Sponsorship and continued with support from the Environmental Protection Agency, was designed to investigate the long-range transport and deposition of sulfur pollutants from utility coal combustion, but the scope has been broadened to acidic deposition from all sources. Many organizations and individuals have contributed to the program; however, the bulk of the research has been conducted by groups at three of the national laboratories; Argonne (ANL), Brookhaven (BNL), and Battelle Pacific Northwest (PNL). The philosophy behind modeling development, a key component of the overall program, has been that progress will be greater with separate numerical modeling programs at each laboratory, coordinated by frequent contact among modelers. This report addresses an intercomparison with data of the Atmospheric Impact of Residual Sulfur Oxide (AIRSOX) model of BNL, the Regional Air Pollutant Transport (RAPT) model of PNL, and the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model of ANL. AIRSOX and RAPT model individual trajectories, while ASTRAP models trajectory ensembles. The models are structured such that they apply to any pollutant in which chemical transformation can be approximated as linear first-order; in this intercomparison, however, only sulfur oxides are examined.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 79, 289, 1113, 1157, 1190

1213 **(DPST—82-767) Effect of averaging time on X/Q and recommendation on 120-hour dose.** Pendergast, M.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 11 Aug 1982. Contract AC09-76SR00001. 7p. NTIS, PC A02/MF A01. Order Number DE84001756.

Observed hourly values of Kr-85 at six sites on the SRP collected during a joint study with the Environmental Measurements Laboratory in 1976 were used to evaluate the relationship between Kr-85 air concentration and averaging time. The results of this analysis indicate that the 99.5% highest observed air concentration at several different averaging times ranging from one hour to 1000 hours is in good agreement with the values obtained by interpolation using the method recommended in Nuclear Regulatory Guide 1.145 (reference 1).

1214 **(N—8323958) Deposition of air-borne Pu-238 near a chemical separation facility.** Horton, J.H.; Gay, D.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA)). Jan 1982. 19p. (DP—1585). NTIS, PC A02/MF A01.

Three methods were compared to measure deposition of Pu-238 released from a chemical separation facility. The methods were: (1) adhesive paper, (2) a collector of rain and dryfall, and (3) soil samples. Excellent agreement among the three methods was found. The measured deposition for the particular source term and meteorological conditions is described by y varies as x to the -1.36th power where y is the pCi of Pu-238 deposited per square meter per mCi Pu-238 released, and x is distance in meters from the source.

1215 **(NVO—260) Analysis of Operation Plumbbob nuclear test: BOLTZMANN radiological and meteorological data.** Steadman, C.R. Jr.; Kennedy, N.C.; Quinn, V.E. (National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office). Sep 1983. Contract AI08-76DP00351. 108p. NTIS, PC A06/MF A01. Order Number DE84001812.

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This report describes the Weather Service Nuclear Support Office (WSNSO) analyses of the radiological and meteorological data collected for the BOLTZMANN nuclear test of Operation PLUMBBOB. Inconsistencies in the radiological data and their resolution are discussed. The methods of converting aerial radiological data to equivalent ground-level values and of estimating fallout arrival times are presented. The meteorological situation on D-day is described. A comparison of the WSNSO fallout analyses with analyses in the late 1950's is presented. The appendices contain tabulated radiological data used in the fallout analyses, and contain discussions of the BOLTZMANN hot spot contention and of the enhanced activity at Portola, California.

1216 **(ORNL-tr—5054) ORION: a computer code for evaluating environmental concentrations and dose equivalent to human organs or tissue from airborne radionuclides.** Shinohara, K.; Nomura, T.; Iwai, M. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). May 1983. Translation of PNCT-N—841-83-42. 75p. NTIS, PC A04/MF A01. Order Number DE84002674.

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The computer code ORION has been developed to evaluate the environmental concentrations and the dose equivalent to human organs or tissue from air-borne radionuclides released from multiple nuclear installations. The modified Gaussian plume model is applied to calculate the dispersion of the radionuclide. Gravitational settling, dry deposition, precipitation scavenging and radioactive decay are considered to be the causes of depletion and deposition on the ground or on vegetation. ORION is written in the FORTRAN IV language and can be run on IBM 360, 370, 303X, 43XX and FACOM M-series computers. 8 references, 6 tables.

1217 **Temporal and spatial distribution of radon-222 and its daughters in complex terrains.** Momeni, M.H.; Carson, J.E. (Argonne National Laboratory, IL). pp 178-182 of 3rd joint conference on applications of air pollution meteorology. Boston, MA; American Meteorological Society (1982). (CONF-820101—).

From 3. joint conference on applications of air pollution meteorology; San Antonio, TX, USA (11 Jan 1982).

The dispersion characteristics in complex terrain near the Uravan mill (Colorado) and St. Anthony mine (New Mexico) were anabatic (up-flow) or katabatic (downflow) flows coupled to the synoptic pattern that changed slowly from sunrise to sunset. Whereas the diurnal distribution of radon and radon daughter concentrations in areas with level terrain is generally dominated by a well-behaved single peak associated with thermal inversion appearing from 4 to 6 a.m., the pattern for regions with complex terrain indicated several minor peaks. The profiles of radon concentration during neutral to stable atmospheric conditions reflected the air flow patterns dominated by topography. The frequency distribution of radon concentration and working level within the canyon demonstrated a sharp rise to a maximum observed frequency, then decreased monotonically and slowly at higher concentrations. But the frequency distribution of radon concentration on the mesa and reliefs was a superposition of several distributions. The frequency distribution and profile of radon concentration and the tracer flow patterns indicated trapping of airborne radionuclides within the canyons during the night.

5005 Site Resource And Use Studies

1218 **(DPST—82-512) Preparation of meteorological data for dose calculations in 1982 SRP reactor safety analysis report (SAR).** Garrett, A.J.; Hoel, D.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 4 Jun 1982. Contract AC09-76SR00001. 53p. NTIS MF A01. Order Number DE84001118.

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This memo documents the preparation of meteorological data taken at the Savannah River Plant (SRP) for use in dose calculations for SRP reactors. The basic data set is five years (1975 to 1979) of 15 minute averages of wind speed, wind direction, and standard deviations of the fluctuations in the horizontal and vertical wind components from the C, K, P, F and H 61m meteorological towers. These data are gathered for use in the SRP WIND Emergency Response System and are archived for use in research and safety analysis applications, such as those described here. Several steps were required to put these data into a form which is suitable for the NRC145 and XOQDOQ dose codes.

5006 Regulations

REFER ALSO TO CITATION(S) 633

1219 **(PB—83-234948) Revisions to continuous emission monitoring systems. Performance specfications 2 and 3 - summary of comments and responses.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1982. 80p. (EPA—450/3-82-022). NTIS, PC A05/MF A01.

This document contains introductory material regarding the proposed revisions (January 26, 1981, 46 FR 8352) to Performance Specifications 2 and 3. The changes made to the proposed revisions are listed along with the comments received and the Administrator's responses to those comments.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 1718

1220 **(ORNL—5983) Current trends in food web theory report on a food web workshop. Environmental Sciences Division Publication No. 2224.** DeAngelis, D.L.; Post, W.M.; Sugihara, G. (eds.). (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 131p. (CONF-8210208—Summs.). NTIS, PC A07/MF A01. Order Number DE84002260.

From Workshop on current trends in food web theory; Fontana Village, NC, USA (25 Oct 1982).

This report summarizes the Food Web Workshop, held at Fontana Village Inn, October 25-27, 1982. The objective of the workshop was to review and assess recent progress in the understanding of ecological food webs. The workshop focused on three main areas: (1) what has been observed of food web patterns (food chain length, intervality, predator-prey ratios, etc.), (2) processes involved in food chains (energy flow and nutrient cycles), and (3) the dynamic behavior of food webs (Lyapunov stability, resilience, etc.). The introduction reviews some of the important contributions to food web theory during the past decade. The synopses of the presentations by invited speakers address many of the specific themes in current thought on food webs.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 180, 181, 1243, 1248, 1357

1221 **(DOE/EV/00641—50) Mineral cycling in soil and litter arthropod food chains. Annual progress report, February 1, 1983-January 31, 1984.** Crossley, D.A. Jr. (Georgia Univ., Athens (USA). Dept. of Entomology). 30 Sep 1983. Contract AS09-76EV00641. 60p. NTIS, PC A04/MF A01. Order Number DE84001776.

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This annual report describes progress in research on the influence of soil fauna on the general process of terrestrial decomposition. The major goal is to investigate the regulation of decomposition by soil arthropods. Methods have included radioactive tracer measurements of food chain dynamics, rates of nutrient or mineral element flow during decomposition, and simulation modeling. This year's report describes significant progress in defining the influence of soil arthropods in stimulating microbial immobilization of nutrients. Preliminary efforts to define the importance of the soil-litter macroarthropods are also reported.

1222 **(N—8323956) Disposal of hazardous wastes in mines: A case study at Norton, Ohio.** (Committee on Energy and Commerce (U.S. House), Washington, DC). 1982. 127p. (GPO—11-518). Avail: Subcommittee on Commerce, Transportation,;and Tourism.

In GPO REFS Hearing before the Subocmm. on Com., Transportation, and Tourism of the Comm. on Energy and Com., 97th Congr., 2nd Sess., 31 Aug. 1982.

Questions with regard to a proposed siting of a hazardous waste storage and disposal facility in an inactive mine are examined.

1223 **(PB—83-241315) Land treatment field studies. Volume 5. Wastewater treatment sludge from batch organic chemical synthesis. Final report Sep 77-Feb 81.** Berkowitz, J.B.; Bysshe, S.E.; Goodwin, B.E.; Harris, J.C.; Land, D.B. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1983. 52p. NTIS, PC A04/MF A01.

This report presents the results of field measurements and observations of a land treatment operation using a sludge generated

from organic chemical manufacture. The sludge is applied to a turf farm which contains acidic soil; the sludge reduces the lime addition requirements for pH adjustment. The sub-soils are porous and the quality of the groundwater located at 20-30′ below the ground surface is pristine.

1224 **(PB—83-241323) Land treatment field studies. Volume 6. Inorganic pickling liquor waste. Final report Sep 77-Feb 81.** Berkowitz, J.B.; Bysshe, S.E.; Goodwin, B.E.; Harris, J.C.; Land, D.B. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1983. 44p. NTIS, PC A03/MF A01.

This report presents the results of field measurements and observations of a land treatment site for the management of an inorganic pickling liquor waste. The waste is spread on the site as a 20% solids sludge. Sulfate and iron are known to be major waste constituents. The organic content of the waste is neglible. The site was sampled twice, and observations were made on the type and amount of waste handled, site characteristics, and management procedures for waste application and monitoring. Organic and inorganic analysis was conducted on the waste and soil/waste mixture; inorganic analysis was performed on plant samples.

1225 **(PNL-SA—11116) Role of soil and plant metabolic processes in controlling trace element behavior and bioavailability to animals.** Cataldo, D.A.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1983. Contract AC06-76RL01830. 13p. (CONF-8310191—1). NTIS, PC A02/MF A01. Order Number DE84002585.

From 21. Hanford life sciences symposium; Richland, WA, USA (4 Oct 1983).

Metabolic and physiological processes regulating the behavior of Ni, Cd, Cr, Np, Pu and Tc in the soil/plant/animal system are discussed. Soil microorganisms have both direct and indirect effects on the trace element solubility in soils. An indirect route, the production of exocellular ligands is briefly discussed in terms of possible effects on plant availability of Ni. The subsequent ability of plant roots to actively accumulate a non-nutrient trace element from soils is dependent on its chemical activity in soil solution, the presence of interfering ions, the requirements for valence change relative to the redox potential of root, and the capacity of the root absorption process. Following absorption by roots, an element is partitioned within the root, and is stored/detoxified and/or metabolized, with only a fraction transported to distal shoot tissues. Inorganic cations and ions are rapidly bound to organic metabolites in root and shoot tissues with only a small fraction persisting in inorganic forms. This change in chemical forms can dramatically affect the availability to individual elements to animals. 43 references.

1226 **Analysis of chamber methods used for measuring nitrous oxide production in the field.** Jury, W.A.; Letey, J.; Collins, T. (University of California, Riverside). *Soil Science Society of America Journal;* **46**: No. 2, 250-256(Mar 1982).

Two current procedures for measuring nitrous oxide (N_2O) production in the field are studied using a two-dimensional model of gas production and diffusion through soil. These procedures consist of trapping the gas as it leaves the soil surface, either by allowing the gas to build up in a closed chamber (closed cover), or by removing and measuring the gas as it leaves the soil (open cover). The model calculations suggest that in many cases, neither measurement relates well to the N_2O production rate because the gas concentration is still building up in the soil. There are also expected differences between the two methods, with the closed cover measurement underestimating the flux from the soil when air contents are relatively high while production is occurring, if gas is allowed to build up in the chamber for more than a few hours. The calculations suggest that, due to the large phase lag caused by gaseous diffusion, the only way to obtain accurate information about the extent of N_2O release to the atmosphere from the soil from a denitrification-reduction event is to trap all gas which is produced by the process. This may require monitoring for up to several weeks after production ceases if soil water content remains high.

1227 **Trace metal chemistry in arid-zone field soils amended with sewage sludge: I. Fractionation of Ni, Cu, Zn, Cd, and Pb in solid phases.** Sposito, G.; Lund, L.J.; Chang, A.C. (University of California, Riverside). *Soil Science Society of America Journal;* **46**: No. 2, 260-64(Mar 1982).

The surface horizons of two arid-zone fields soils that had received amendments of either liquid or dried, anaerobically digested sewage sludge for 4 years were sampled to determine the forms of selected trace metals in the solid phase. The soils had been amended with sludge twice annually at rates of 0, 22.5, 45.0, or 90.0 tons . ha^{-1} . $year^{-1}$. Barley and sorghum had been grown on the soils in randomized experimental plots. The soil samples were analyzed for total Ni, Cu, Zn, Cd, and Pb and were fractionated by sequential extraction to estimate the quantities of these metals in "exchangeable," "sorbed," "organic," "carbonate," and "sulfide" forms. The total contents of the five metals in the two field soils were governed by the total content of the metals in the sludges applied and by the rate of sludge application. The accumulation of metals in the surface horizons of field plots receiving liquid sludge was less than that in the plots receiving composted sludge, possibly because of a lesser reduction in soil bulk density resulting from sludge applications. The percentage of the total metal content in exchangeable and sorbed forms was very low, averaging between 1.1 and 3.7% for all of the metals regardless of the type of soil, the form of sludge applied, or the sludge application rate. The application of sludge tended to reduce the sulfide fraction and to increase the organic and carbonate fractions of all five trace metals. At the highest rate of sludge application, the predominant forms of the metals were: Ni, sulfide; Cu, organic; and Zn, Cd, and Pb, carbonate.

1228 **Trace metal chemistry in arid-zone field soils amended with sewage sludge: II. Comparative study of the fulvic acid fraction.** Sposito, G.; Holtzclaw, K.M.; LeVesque, C.S.; Johnston, C.T. (University of California, Riverside). *Soil Science Society of America Journal;* **46**: No. 2, 265-70(Mar 1982).

The elemental composition, infrared spectrum, and proton titration curve were determined for (i) the fulvic acid fraction of a Domino soil which had received applications of composted sewage for three years in a field experiment, and (ii) a commercially available fulvic acid extracted from a spodosol. Data showed that the Domino fulvic acid more resembled a typical sludge-derived fulvic acid than a fulvic acid extracted from natural soil organic matter. The distinguishing features of the Domino fulvic acid which led to this conclusion were: (i) a high total sulfur (S) content and the presence of sulfonyl groups, (ii) a significant content of anionic surfactants and S-containing amino acids, (iii) a low glucosamine/galactosamine ratio, and (iv) more than two classes of acidic functional groups. However, the Domino fulvic acid had a much larger content of carboxyl and other acidic functional groups than a typical sludge-derived fulvic acid, evidently because of partial oxidation of the sludge in the Domino soil.

1229 **The use of soda-lime for measuring respiration rates in terrestrial systems.** Edwards, N.T. (Oak Ridge National Laboratory, TN). *Pedobiologia;* **23**: 321-330(1982). Contract W-7405-ENG-26.

A granular mixture of sodium hydroxide and slaked lime, was tested as a potential alternative to alkali solutions for absorbing carbon dioxide (CO_2) as an indicator of soil respiration rates. Because soda-lime can be used as a solid, problems with freezing and spillage are eliminated. Also, no titration is necessary; the only measurement needed is the dry weight of the soda-lime before and after the absorption period. A 0.2 N solution of potassium hydroxide (KOH) absorbed 38% as much CO_2 as soda-lime measured simultaneously under identical field conditions and only 22% as much in the laboratory. In the field, variability between plots was much greater with soda-lime than with KOH. However, this variability was apparently a reflection of actual spatial variability of soil CO_2 efflux, because under homogeneous conditions in the laboratory variability was quite low (SD ca.8% of the mean) and about the same for both KOH and soda lime. In field plots, greater proportional increases in net CO_2 absorptive capacity were produced by increasing the weight per unit surface area than by increasing

the surface area per unit weight. No significant ($P<0.01$) increase in net CO_2 values was observed with soda-lime surface exceeding 32 cm^2 (5% of the measured forest floor surface) and amounts greater than 30 g.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 251, 282, 288, 289, 290, 886, 1157, 1162, 1214, 1216, 1221, 1253, 1319

1230 **(DOE/EV/10305—9) ^{226}Ra contamination of soil and foliage as a function of distance downwind from uranium mill tailings.** Skinner, D.J. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Fal 1982. Contract AC02-79EV10305. 46p. NTIS, PC A03/MF A01. Order Number DE84001801.

Thesis.

This study concerned ^{226}Ra contamination of soils and foliage as a function of distance downwind from a uranium mill tailings pile. In soils the radium contamination was primarily associated with particle sizes < 0.045 mm and mainly found within the 0 to 0.6 cm soil horizon. The soil showed a decrease in activity concentration with distance. An attempt was made using ultrasonic washing to separate internal from external ^{226}Ra contamination in Artemisia tridentata. Internal contamination appeared to be a larger contributor to total contamination at distances ≦ 0.16 km downwind from the tailings pile. At distances > 0.16 km, external contamination became a larger contributor to the total ^{226}Ra contamination. In most soil samples ^{226}Ra concentrations approached background levels at a distance of 1.1 km from the tailings pile. Total vegetation contamination approached background at 6.6 km. This study suggested that a combination of root uptake and foliar absorption were responsible for internal contamination and further studies were suggested. 19 references, 5 figures, 2 tables.

1231 **(DOE/EV/10305—10) Field experiment on ^{222}Rn flux from reclaimed uranium tailings.** Hinton, T.G. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Spr 1983. Contract AC02-79EV10305. 44p. NTIS, PC A03/MF A01. Order Number DE84002054.

Thesis.

Design and construction techniques are described for a 1.6 ha experimental uranium mill tailings reclamation plot. A passive, activated charcoal device was developed and tested for measurements of radon flux. Experiments on radon flux versus overburden depth showed that tailings covered with 1.5 m of revegetated or 0.3 m of bare overburden had exhalation rates comparable to background. Vegetated subplots exhibited a significantly higher (often an order of magnitude) flux than the bare subplots. Results on the variation of flux over time did not reveal any definitive patterns, possibly due to the high variability among replicates. A positive correlation was demonstrated between precipitation and radon flux. This is discussed in detail and possibly explained by the increase in water content of the micropores within the tailings, which increases the emanation coefficient without adversely effecting the diffusion coefficient of the overburden. 30 references, 7 figures, 3 tables.

1232 **(DOE/EV/10305—11) Radioecological investigations of uranium-mill-tailings systems. Fourth technical progress report, October 1, 1982-September 30, 1983.** Whicker, F.W.; Ibrahim, S.A. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 15 Oct 1983. Contract AC02-79EV10305. 89p. NTIS, PC A05/MF A01. Order Number DE84001803.

This document provides a status report on studies which address some of the problems and questions on the integrity and transport of several radionuclides in active and reclaimed uranium mill tailings. The studies reported are being conducted at the Shirley Basin Uranium Mine, located in southeastern Wyoming. The investigation quantitatively evaluates the potential release of important radionuclides from active and reclaimed uranium mill tailings and their entry into the food chain. For active mill tailings, we are trying to quantify the degree of escape and dispersal, primarily by wind, and to measure the accumulation of ^{238}U, ^{230}Th, ^{226}Ra, ^{210}Pb and ^{210}Po by various native plants. Of particular interest are the relationships between soil and vegetation at different sites, since the chemical environment of areas impacted by mill tailings are drastically different than undisturbed natural areas. Also of great interest, is the relative importance of various mechanisms of radionuclide accumulation by plants, such as root uptake and aerial deposition, followed by some degree of foliar absorption. This investigation includes as a major component, studies relating to the final disposal of mill tailings. Experiments on radon flux versus overburden depth showed that tailings covered with 1.5m of revegetated or 0.3m of bare overburden had exhalation rates comparable to background. A positive correlation was demonstrated between precipitation and radon flux.

1233 **(DPST—83-672) Cs-137 from nuclear-weapons tests.** Hayes, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 14 Jan 1983. Contract AC09-76SR00001. 5p. NTIS, PC A02/MF A01. Order Number DE84000200.

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The results of air monitoring indicate about 80 Ci of Cesium 137 have been deposited on the Savannah River Plant (SRP) as fallout from nuclear weapons testing. About 1% of this amount has been transported down the river. About 500 Ci of Cs-137 have been discharged to the surface streams of the SRP by SRP operations. About 20% has been transported down river. (ACR)

1234 **(IAEA-SR—84/4) Uncertainties in radioecological assessment models.** Hoffman, F.O.; Miller, C.W.; Ng, Y.C. (Oak Ridge National Lab., TN (USA); Lawrence Livermore National Lab., CA (USA)). 1983. Contract W-7405-ENG-26. 21p. (CONF-831032—1). NTIS, PC A02/MF A01. Order Number DE84001965.

From Seminar on the environmental transfer to man of radionuclides released from nuclear installations; Brussels, Belgium (17 Oct 1983).

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Environmental radiological assessments rely heavily on the use of mathematical models. The predictions of these models are inherently uncertain because models are inexact representations of real systems. The major sources of this uncertainty are related to bias in model formulation and imprecision in parameter estimation. The magnitude of uncertainty is a function of the questions asked of the model and the specific radionuclides and exposure pathways of dominant importance. It is concluded that models developed as research tools should be distinguished from models developed for assessment applications. Furthermore, increased model complexity does not necessarily guarantee increased accuracy. To improve the realism of assessment modeling, stochastic procedures are recommended that translate uncertain parameter estimates into a distribution of predicted values. These procedures also permit the importance of model parameters to be ranked according to their relative contribution to the overall predicted uncertainty. Although confidence in model predictions can be improved through site-specific parameter estimation and increased model validation, health risk factors and internal dosimetry models will probably remain important contributors to the amount of uncertainty that is irreducible. 41 references, 4 figures, 4 tables.

1235 **(UCRL—89766) Selection of terrestrial transfer factors for radioecological assessment models and regulatory guides.** Ng, Y.C.; Hoffman, F.O. (Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-48. 16p. (CONF-831032—3; IAEA-SR—85/56). NTIS, PC A02/MF A01. Order Number DE84002721.

From Seminar on the environmental transfer to man of radionuclides released from nuclear installations; Brussels, Belgium (17 Oct 1983).

A parameter value for a radioecological assessment model is not a single value but a distribution of values about a central value. The sources that contribute to the variability of transfer factors to predict foodchain transport of radionuclides are enumerated. Knowledge of these sources, judgement in interpreting the available data, consideration of collateral information, and established criteria that specify the desired level of conservatism in the resulting predictions are essential elements when selecting appropriate parameter

values for radioecological assessment models and regulatory guides. 39 references, 4 figures, 5 tables.

1236 **Comparative behavior of ^{99}Tc, ^{129}I, ^{127}I, and ^{137}Cs in the environment adjacent to a fuels reprocessing facility.** Garland, T.R.; Cataldo, D.A.; McFadden, K.M.; Schreckhise, R.G.; Wildung, R.E. (Pacific Northwest Laboratory, Richland, WA). *Health Physics;* **44**: No. 6, 658-662(Jun 1983).

The distribution of Tc-99, I-129, I-127 and Cs-137 was measured in the surface soil profile and vegetation in the vicinity of a nuclear fuels reprocessing facility located on the Hanford Reservation in Washington State. Cs-137 was measured by counting activation of the chemically-separated iodine fraction with subsequent gamma-coincidence spectroscopic detection of activated iodine isotopes; Tc-99 was measured by chemical dilution mass spectroscopy or low-level beta counting. In the case of vegetation samples both methods of Tc-99 detection were applied with good agreement. For soil samples, the beta counting method was insufficiently sensitive and isotope dilution mass spectroscopy was used exclusively. Results show that the radionuclide behavior in soils and plants is quite complex. Soil sorption and mobility, while expected to differ for individual elements, appear to differ for isotopes of the same element due to differences in chemical form. Concentration ratio values, although known to exhibit a broad range for a given element, are most likely affected by plant rooting behavior and plant species differences in the present study.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 199, 232, 235, 236, 257, 269, 291, 300

1237 **(PB—83-239939) Technologies and management strategies for hazardous waste control. volume 2. Working papers. Part A. Hazardous waste categories: review of literature and past research effort.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1983. 361p. NTIS, PC A16/MF A01.

This volume contains papers written for OTA to assist in preparation of the report TECHNOLOGIES AND MANAGEMENT STRATEGIES FOR HAZARDOUS WASTE CONTROL. The contents include Hazardous waste categories, a review of literature and past research effort.

1238 **(PB—83-239947) Technologies and management strategies for hazardous waste control. Volume 2. Working pApers. Part B. application of biotechnology to hazardous waste disposal.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1983. 174p. NTIS, PC A08/MF A01.

This volume contains papers written for OTA to assist in preparation of the report TECHNOLOGIES AND MANAGEMENT STRATEGIES FOR HAZARDOUS WASTE CONTROL. The contents include application of biotechnology to hazardous waste disposal.

1239 **(PB—83-239954) Technologies and management strategies for hazardous waste control. Volume 2. Working papers. Part C. Classification by degree of hazard for selected industrial waste streams.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1983. 231p. NTIS, PC A11/MF A01.

This volume contains papers written for OTA to assist in preparation of the report TECHNOLOGIES AND MANAGEMENT STRATEGIES FOR HAZARDOUS WASTE CONTROL. The contents include classification by degree of hazard for selected industrial waste streams.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 1220, 1718

1240 **Factors affecting the amperometric determination of trace quantities of total residual chlorine in seawater.** Wong, G.T.F. (Old Dominion University, Norfolk, VA). *Environmental Science and Technology;* **16**: No. 11, 785-790(Nov 1982). Contract AS05-77EV05572.

The standard scheme for the determination of total residual chlorine in seawater by amperometric titration is not suitable for many recent studies that require lower and lower detection limits (<0.1 mg L^{-1} or <1.4 μequiv L^{-1}). The interference of iodate that originated from the reaction between iodide and hypobromite and from naturally occurring iodate in seawater may yield variable blank and/or grossly underestimated results. The pH chosen in the present analytical scheme is at a value where the reaction between iodate and iodide is sluggish and the extent to which iodate is converted to triiodide is most sensitive to small pH changes. A titration at pH 2 will yield the true concentrations of total residual chlorine after the contribution from naturally occurring iodate is corrected for. The interference from nitrite should be considered if a submilligram per liter level of residual chlorine is to be measured and/or if the titration is carried out at a pH below 3. This interference may be removed by the addition of sulfamic acid.

1241 **The northwestern Indian Ocean during the monsoons of 1979: distribution, abundance, and feeding of zooplankton.** Smith, S.L. (Brookhaven National Lab., Upton, NY). *Deep-Sea Research;* **29**: No. 11A, 1331-1353(1982). Contract AC02-76CH00016.

Upwelling induced by the separation of the Somali Current from the coast of east Africa is associated with low surface temperatures, high concentrations of nitrate, and blooms of phytoplankton. Coefficients of concordance, based upon 17 taxa of zooplankton collected at 33 stations in the southwest monsoon and 15 stations in the northeast monsoon, were consistently larger for the southwest monsoon and indicative of a general response of the zooplankton in the northwestern Indian Ocean. The largest coefficients of concordance in the southwest monsoon were among adult females of Paracalanus denudatus, Paracalanus parvus, and Paracalanus aculeatus and of Calanoides carinatus and Eucalanus spp. Coefficients of concordance among copepodids of six taxa had a trend similar to adult females in the southwest monsoon. During the southwest monsoon, total biomass of zooplankton was significantly greater within areas of upwelling than outside; adult females and copepodids of C. carinatus and Eucalanus spp. were significantly more abundant within the upwelling regions, along with adult females of Clausocalanus furcatus and Clausocalanus minor. The upwelling regions, which are associated with a reproductively active population of the large-bodied C. carinatus, are the primary features affecting distributions of zooplankton during the southwest monsoon and the main difference between monsoons. The ontogenetic migration of C. carinatus is essentially an annual life-history strategy and therefore on the same temporal scale as the reversals in the monsoonal winds and associated upwelling. The ability of C. carinatus to ingest readily the diatoms that dominate the upwelling regions and to store lipid is crucial to its dominance of the areas of upwelling both in numbers and biomass.

1242 **The stability of molecular iodine in seawater.** Wong, G.T.F. (Old Dominion University, Norfolk, VA). *Marine Chemistry (Amsterdam);* **11**: 91-95(1982). Contract AS05-77EV05572.

Both theoretical considerations and laboratory studies suggest that molecular iodine undergoes rapid hydrolysis to form hypoiodite when it is added to seawater. Previous experimental designs were not suitable for studying the fate of molecular iodine in seawater.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 442, 472, 1179, 1189, 1300

1243 **(CONF-821048—8) Forecasting fate and effects of aromatic hydrocarbons in aquatic systems.** Bartell, S.M. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01. Order Number DE84001998.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

Statistical regressions were used to estimate parameters in transport and effects models from basic molecular characteristics of organic hydrocarbons. Uncertainties associated with parameter estimates were carried through forecasts of fate of naphthalen, anthracene, and benzo(a)pyrene by means of repeated simulation with parameter sets selected randomly from distributions defined by the regression statistics. Effects of phenol on algal production were similarly forecast. The combined use of structure-activity regressions, transport or effects models, and Monte Carlo simulation might provide a partial solution to the problem of screening a large number of potential toxic chemicals.

1244 **(DOE/EV/10611—3) Increase of total CO_2 in the world ocean.** Rodman, M.R. (Oregon State Univ., Corvallis (USA). School of Oceanography). 1982. Contract AT06-81EV10611. 41p. NTIS MF A01. Order Number DE84001107.

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Accomplishments since January 1981 are: new instrumentation has been developed; samples have been collected from four cruises; and the depth of oceanic excess CO_2 penetration has been mapped in heretofore unmapped regions and correlated with transient tracers data. Of particular significance in these accomplishments is the demonstration of our ability to generate state-of-the-art calcium, oxygen, pH, alkalinity and total CO_2 data. The Pacific Ocean data led to the calculation of the depth of the excess CO_2 penetration across the Subpolar Front, which has not been achieved before. The Weddell and the Bering Sea data are the only comprehensive winter carbonate data sets collected in these subsurface-water-formation regions. These winter data supplement nicely the larger GEOSECS and TTO summer data sets and greatly increased our ability to obtain the preformed CO_2 concentrations.

1245 **(GKSS—83/E/14) Comparison of laser-light diffraction method with other methods of analyzing the particle size distribution in suspensions of latex, pollen, and quartz, and in suspended particulate matter in river water.** Heyn, R.D.; Zimmermann, H.U. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE83751318.

This report gives an idea of different methods being used for the particle size analysis, including a laser light diffraction method and an image analysis method. These comparing measurements have been carried out with suspensions consisting of fresh water and standard particles, ranging between 1 and 100 μm, as well as with suspended particulate matter of the Elbe river. As to standard particles, statistical errors are subject to the width of the size distribution. When using the light diffraction method, the errors vary between 0,7 and 16%, however, when applying the image analysis method, they range between 0,5 and 26%. As a result of the measurements of the suspended particulate matter of the Elbe river, a statistical error of 21% has occured with regard to the image analysis method, whilst the light diffraction method has shown an error of about 4 - 11%. Possible reasons for systematical and random errors have been discussed as to both of these methods.

1246 **(NUREG/CR—3358) Concentration and distribution of copper in effluents from three freshwater nuclear power stations.** Harrison, F.L.; Bishop, D.J.; Rice, D.W. Jr.; Emerson, R.; Smith, B.J. (Lawrence Livermore National Lab., CA (USA)). Sep 1983. Contract W-7405-ENG-48. 54p. (UCRL—53482). NTIS, PC A04/MF A01 - GPO. Order Number DE84001428.

The concentrations and physicochemical forms of copper were determined in samples from the water column and bedload sediments in the intake and discharge zones of the Vermont Yankee, Kewaunee, and Fort St. Vrain Nuclear Power Stations. These stations differ in their mode of operation and in the composition of water circulated in their cooling systems. In addition, at Vermont Yankee, water samples were collected during changeover from open- to closed-cycle operation, and water and sediment samples were collected from the base of the cooling tower during closed-cycle operation. Copper concentrations were obtained for the soluble, including labile and bound, and particulate fractions of water samples and for bedload sediments collected in discharge and intake areas during the winter, spring, and summer months of 1978. The apparent copper complexing capacity (ACC), the dissolved organic carbon content (DOC), and the percentages of copper in different molecular-weight fractions were also determined for the soluble fraction of water samples. In addition, copper distribution coefficients (K/sub d/s of particles suspended in the water column and present in the bedload sediment were determined. 41 references, 10 figures, 20 tables.

1247 **(TVA/ONR/WR—83/12) Productivity of the aquatic macrophyte community of the Holston River: implications to hypolimnetic oxygen depletions of Cherokee Reservoir.** Young, R.C.; Dennis, W.M. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Air and Water Resources). Feb 1983. 40p. NTIS, PC A03/MF A01. Order Number DE84900270.

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Studies were initiated in 1979 to evaluate the extensive aquatic macrophyte beds on the Holston River in upper east Tennessee. The primary aim of these studies was to determine if allochthonous input from drifting aquatic plant debris was a significant factor contributing to low dissolved oxygen (DO) levels in Cherokee Reservoir located downstream. This report presents the results of studies conducted in 1979-1980 to obtain refined estimate of the impact of allochthonous aquatic macrophyte input on DO levels in Cherokee Reservoir. The report also details phenological aspects of the growth and reproduction of the various species that comprise the submersed aquatic macrophyte community of the Holston River above Cherokee Reservoir and discusses the contribution of each to net primary productivity of the river. 31 references, 9 figures, 4 tables.

1248 **(UCRL—53416) Evaluation of the hydrogeology and groundwater chemistry associated with landfills at LLNL's Site 300.** Raber, E.; Carpenter, D.W. (eds.). (Lawrence Livermore National Lab., CA (USA)). Jun 1983. Contract W-7405-ENG-48. 144p. NTIS, PC A07/MF A01. Order Number DE84001926.

Potential groundwater contamination from eight solid waste landfills within LLNL's Site 300 has been assessed. Investigations included extensive geological, hydrological, geophysical, and geochemical studies directed toward an evaluation of hydrogeology and groundwater chemistry in the vicinity of the landfill locations. A state-of-the-art groundwater sampling system was installed, which allows for collection of samples and piezometric measurements from discrete isolated sampling zones. Multiple completions were made in eight of the 17 boreholes completed for groundwater sampling, to permit analysis of deeper aquifers as well as the uppermost water-bearing zone (the water table). To prevent cross-contamination between aquifers during drilling, an aquifer isolation technique was developed. Special precautions were taken in drilling and well completion procedures to minimize the introduction of contaminants. Three separate sets of hydrological measurements and chemical analyses were made to identify the direction of groundwater flow from the landfills and to establish whether any contaminants had been introduced into the groundwater. No groundwater contamination levels were found that would threaten human health or the environment. 80 references.

1249 **(USGS-OFR—79-684) Preliminary study of wastewater movement in Yellowstone National Park, Wyoming, October 1976 through September 1977.** Cox, E.R. (Geological Survey, Cheyenne, WY (USA)). Mar 1979. 69p. NTIS, PC A04/MF A01. Order Number DE84900247.

This report describes hydrologic data collected and some preliminary interpretations for a study by the US Geological Survey in cooperation with the National Park Service to determine the effects on nearby lakes and streams of wastewater effluents that percolate from sewage lagoons at four sites in Yellowstone Natinal Park. A network of observation wells has been established near the sites, and water-level and water-quality data have been collected. Ground-water mounds have built up under the lagoons as percolation of effluents occurred. Percolating effluents mix with ground water and move down the hydraulic gradient in a direction generally perpendicular to the water-level contours. Chloride and sulfate concentrations and specific conductance of water in wells, and water-level contours indicate the most likely areas and directions of movement of percolating effluents. The most likely directions of movement are: Fishing Bridge, southwestward toward the Yellowstone River; Old Faithful, northward and northeastward toward Iron Spring Creek; Madison Junction, southeastward toward the Madison River; and Grant Village, northward Yellowstone Lake, northwestward, and westward. 2 references, 14 figures, 4 tables.

1250 **Runoff fraction and pollution levels in runoff from a waste rock dump undergoing pyritic oxidation.** Harries, J.R.; Ritchie, A.I.M. (Lucas Height Research Laboratory, Sutherland, Australia). *Water, Air, and Soil Pollution;* **19**: No. 2, 155-170(Feb 1983).

Measurements have been made of rainfall, runoff and pollution levels in runoff on a waste rock dump in which soluble salts are produced by pyritic oxidation. The dump is overburden material from the opencut mining of White's uranium orebody at Rum Jungle in the Northern Territory of Australia where there is a pronounced wet/dry season cycle. Most of the data were collected in the 1975-76 and 1976-77 wet seasons with some from the 1977-78 wet season. Events monitored in the first two wet seasons accounted for about half the rainfall in each. The runoff fraction, which averaged 15.6% over the two seasons, ranged up to a maximum of 33%. Calculations of the runoff fraction using measured sorptivities and hydraulic conductivities predicted an even lower runoff fraction than that observed. The SO_4 concentrations in runoff varied in a well defined way throughout the discharge events and showed no significant dependence on the history of rainfall on the dump.The average SO_4 level in runoff was 0.84 kg m^{-3}; Cu, Zn, Mn levels were respectively 1.0, 0.15, and 0.09% of the SO_4 levels. The annual Cu load in runoff was estimated to be 0.4 t which is much smaller than the estimated release of 39 to 53 t in water seeping through the dump.

1251 **Chemical composition and spatial variation of bulk precipitation at a coastal plain watershed in South Carolina.** Richter, D.D.; Ralston, C.W.; Harms, W.R. (Duke Univ., Durham, NC). *Water Resources Research;* **19**: No. 1, 134-140(Feb 1983). Contract W-7405-ENG-26.

Bulk precipitation was collected for analysis of ionic constituents at eight rainfall stations over a 4-year period at a 500-ha watershed in the Lower Coastal Plain of South Carolina. Mean annual deposition rates of ions in greatest supply, Cl^-, SO_4^{2-}-S, Ca^{2+}, and Na^+, were respectively 14.2, 7.51, 5.69, and 5.66 kg/ha. Annual deposition rate for total inorganic N (NH_4^+-N plus NO_3^--N) was about 2.6 kg/ha and for orthophosphate-P about 0.12 kg/ha. Spatial variation of annual depositions to the eight rainfall stations was smallest for SO_4^{2-}, NO_3^-, and Ca^{2+}, with coefficients of variation (CV) less than 10%. Variation of annual inputs of the eight collectors was intermediate for Mg^{2+}, Cl^-, H^+, and Na^+ with CV ranging between 13.9 and 21.5%, whereas the CV for annual inputs of NH_4^+, PO_4^{3-}, and K^+ exceeded 30%. Sample size estimates for this 500-ha watershed indicated that 19 collectors should provide estimates of the annual bulk precipitation inputs within 10% of true means for 7 of 10 ions (SO_4^{2-}, NO_3^-, Ca^{2+}, Mg^{2+}, Cl^-, H^+, and Na^+) and that more than 35 collectors would be necessary to provide similar confidence intervals for annual inputs of NH_4^+, PO_4^{3-}, and K^+ (+/- 10% at $P < 0.05$). Although estimates of annual bulk precipitation inputs may be quite variable over local areas, control of sampling errors can be gained by increasing the number of collectors.

1252 **Micropollutants produced by disinfection of wastewater effluents.** Jolley, R.L.; Cumming, R.B.; Lee, N.E.; Thompson, J.E.; Lewis, L.R. (Oak Ridge National Lab., TN). *Water Science and Technology;* **14**: 45-59(1982). Contract W-7405-ENG-26.

In a comparative study of highly concentrated samples of effluents from nine wastewater treatment plants, it was determined that disinfection with chlorine or ozone both destroys and produces nonvolatile organic constituents including mutagenic constituents. The chemical effects of disinfection by uv irradiation were relatively slight, although the mutagenic constituents in one effluent were eliminated by this treatment.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 254, 264, 286, 287, 289, 909, 1157, 1233, 1234

1253 **(DOE/EV/73012—T1) Factors influencing the transport of actinides in the groundwater environment. Final report.** Sheppard, J.C.; Kittrick, J.A. (Washington State Univ., Pullman (USA)). 31 Jul 1983. Contract AT06-76EV73012. 43p. NTIS, PC A03/MF A01. Order Number DE83017480.

This report summarizes investigations of factors that significantly influence the transport of actinide cations in the groundwater environment. Briefly, measurements of diffusion coefficients for Am(III), Cm(III), and Np(V) in moist US soils indicated that diffusion is negli ible compared to mass transport in flowing groundwater. Diffusion coefficients do, however, indicate that, in the absence of flowing water, actinide elements will migrate only a few centimeters in a thousand years. The remaining investigations were devoted to the determination of distribution ratios (K/sub d/s) for representative US soils, factors influencing them, and chemical and physical processes related to transport of actinides in groundwaters. The computer code GARD was modified to include complex formation to test the importance of humic acid complexing on the rate of transport of actinides in groundwaters. Use of the formation constant and a range of humic acid, even at rather low concentrations of 10^{-5} to 10^{-6} molar, significantly increases the actinide transport rate in a flowing aquifer. These computer calculations show that any strong complexing agent will have a similar effect on actinide transport in the groundwater environment. 32 references, 9 figures.

1254 **(DPST—81-482) Data report summarizing water quality and Cs-137 transport in Steel Creek during a P-Area discharge in November 1980.** Hayes, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 12 Aug 1981. Contract AC09-76SR00001. 42p. NTIS, PC A03/MF A01. Order Number DE84001554.

Extremes in water quality unfavorable to the biota of Steel Creek were not detected during diversion of 32,000 gpm of ambient temperature water from P Area to Steel Creek. The small changes in water quality that were observed are considered within the normal range expected for this creek as a result of natural flow variation. Suspended sediment and Cs-137 concentrations were increased a factor of 3 to 4 above background due to stream bed erosion adjacent to P Area. These increased concentrations were reduced to normal levels 6 miles downstream from P Area. No significant change in Cs-137 concentrations was measured at the point where Steel Creek water flows into the Savannah River swamp.

1255 **(DPST—82-212) Anticipated transport of Cs-137 from Steel Creek following L-Area restart.** Hayes, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 7 Jan 1982. Contract AC09-76SR00001. 158p. NTIS, PC A08/MF A01. Order Number DE84001555.

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Heat exchanger cooling water, spent fuel storage basin effluents, and process water from P and L-Reactor Areas were discharged to Steel Creek beginning in 1954. Cs-137 was the most significant radionuclide discharged to the environs. Once the Cs-137 was discharged from P and L-Area reactors to Steel Creek, it

became associated with silt and clay in the Steel Creek system. After its association with the silt and clay, the Cs-137 becomes part of the sediment transport process and undergoes continual deposition-resuspension in the stream system. This report discusses the expected fate and transport of Cs-137 currently present in the Steel Creek system after L-Reactor restart.

1256 **(DPST—82-1077) Cs-137 in the Savannah River and the Beaufort-Jasper and Port Wentworth water-treatment plants.** Hayes, D.W.; Boni, A.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 10 Jan 1983. Contract AC09-76SR00001. 12p. NTIS, PC A02/MF A01. Order Number DE84000674.

Cesium-137 concentration measurements made in 1965 are reported for the Savannah River above and below the Savannah River Plant (SRP) and for the Beaufort-Jasper and Port Wentworth water treatment plants down river. These concentrations, measured when four SRP reactors (C, K, L, and P) were operating, were used to estimate Cs-137 reduction ratios for transport in the Savannah River and across each water treatment plant. In 1965 there was a 48% reduction in the Cs-137 concentration in the Savannah River between Highway 301 and the water treatment plant inlet points. Measured Cs-137 values in the finished water from Port Wentworth and the Beaufort-Jasper water treatment plants showed an 80% and 98% reduction in concentration level, respectively, when compared to Cs-137 concentration at Highway 301. The lower Cs-137 concentration (0.04 pCi/l) in the Beaufort-Jasper finished water is attributed to dilution in the canal from inflow of surface water (40%) and sediment cleanup processes that take place in the open portions of the canal (about 17 to 18 miles). Using the 1965 data, maximum Cs-137 concentrations expected in finished water in the Beaufort-Jasper and Port Wentworth water treatment plants following L-Reactor startup were recalculated. The recalculated values are 0.01 and 0.09 pCi/l for Beaufort-Jasper and Port Wentworth, respectively, compared to the 1.05 pCi/l value in the Environmental Assessment.

1257 **(DPST—83-679) Cs-137 concentrations in the Beaufort-Jasper Canal and water-treatment-plant sludge.** Hayes, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 18 Jan 1983. Contract AC09-76SR00001. 4p. NTIS, PC A02/MF A01. Order Number DE84000394.

This short report presents additional information on Cs-137 concentrations in the canal sediments and sludge in Beaufort-Jasper Water system. From 10 years of L-Reactor operation, it was conservatively predicted in the L-Reactor Environmental Assessment that about 41 Curies of Cs-137 would be transported from Steel Creek and into the Savannah River. Recent studies have provided an improved basis for these calculations and it is now expected that about 14 Curies will be moved in the first ten years. At a water usage rate of 8,000,000 gallons per day of Savannah River water for ten years, a maximum of about 0.02 Curies of Cs-137 could end up in the Beaufort-Jasper canal sediments and treatment plant sludge. Based on river dilution and transport of Cs-137, a more likely amount would be 0.01 Curies in ten years.

1258 **(DPST—83-689) Environmental consequences of alternatives to L Reactor restart.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 19 Aug 1983. Contract AC09-76SR00001. 29p. NTIS, PC A03/MF A01. Order Number DE84001758.

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Alternatives to renewed L-Reactor operation for increased production of nuclear materials are: restart of R Reactor, construction and operation of a New Production Reactor (NPR), increased throughput of SRP reactors C, K, and P and N Reactor at Hanford, restart of K Reactors at Hanford, and no action - standby ready state for L Reactor. This report compares the environmental consequences from the proposed L-Reactor restart and these alternatives. The environmental consequences considered are radiological releases, radiocesium remobilization, nonradiological releases, ecological impacts and transportation.

1259 **(IAEA-SR—85/4) International Union of Radioecologists' activities.** Auerbach, S.I. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 9p. (CONF-831032—2). NTIS, PC A02/MF A01. Order Number DE84001958.

From Seminar on the environmental transfer to man of radionuclides released from nuclear installations; Brussels, Belgium (17 Oct 1983).

The International Union of Radioecologists (I.U.R.) has maintained a vigorous program of activities in accordance with the goals of its charter. To meet these goals, the I.U.R. has sponsored a number of workshops, meetings, and other related activities aimed at improving our ability to understand and predict the consequences of release of radionuclides to the environment. These include: intercomparison and harmonization of methodologies and a continuous feedback between scientists engaged in mathematical modeling and those carrying out field studies. Specialized workshops dealing with problems in understanding transfer coefficients in the terrestrial environment are being held. In the marine environment, long-distance transport in sediments plays an important role for the spread of radioisotopes released from reprocessing plants (e.g., in the Eastern Atlantic, the Northland Baltic Sea). Representatives of the countries concerned (including from Northern Countries) will define conditions of information exchange, sampling (time, character of sediments), and modelisation.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 517, 739, 1258

1260 **(DPST—82-990) Biological measurement program in the Savannah River. Interim report, 1 March-31 May 1982.** (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Sep 1982. Contract AC09-76SR00001. 98p. NTIS, PC A05/MF A01. Order Number DE84000205.

The program was designed to provide data on the biological communities in the river that might be directly affected by the present and proposed activities at the Savannah River Plant. The density and distribution of ichthyoplankton and benthic macroinvertebrate meroplankton was determined in the river, nearby creeks and the intake canals. The potential impact of the present and proposed cooling water intake rates on aquatic organisms was evaluated. The potential impact of existing and proposed increased thermal discharges was evaluated. The rate of impingement of fishes at the cooling water intake screens was determined.

1261 **(DPST—83-775) Fisheries mitigation options for direct discharge of L-Reactor cooling water.** Muska, C.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1 Aug 1983. Contract AC09-76SR00001. 11p. NTIS, PC A02/MF A01. Order Number DE84002666.

This report proposes mitigation options to replace and/or compensate for the effects on fish due to the direct discharge of L-Reactor cooling water. Fisheries mitigation options include: (1) restocking selected fish species obtained from local hatcheries and/or from a SRP site hatchery; (2) establishing a fisheries/wildlife preserve to protect wetlands which are structurally and functionally similar to the Steel Creek swamp system; and (3) supporting or conducting fisheries research on the Savannah River and/or the development of culture techniques for fish species not currently raised for restocking purposes. Details of each of these options and estimated implementation costs are discussed.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 285, 300, 522

1262 **(AD-A—130379/1) Movement, transport, and scour of particulate organic matter and aquatic invertebrates downstream from a peaking hydropower project. Final report.** Matter, W.; Hudson, P.; Nestler, J.; Saul, G. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). May 1983. 64p. NTIS, PC A04/MF A01.

The Savannah River below Lake Hartwell, Georgia-South Carolina, receives hypolimnetic water discharged from the reservoir for peak power generation. Invertebrates and particulate organic material (POM) in the water column were collected during a 24-hr release cycle at sites 1.0, 4.5, and 12.5 km downstream from the dam. Water released during generation reached a maximum discharge of 688 cum/sec. River discharge was less than 10 cum/sec during nongeneration periods. Highest POM concentrations were associated with the initial downstream surge of water at the start of power generation; values were 200 to 400 times greater than those during nongeneration periods. Of the drifting invertebrates, 80 to 93 percent originated in the reservoir; the rest, primarily Oligochaeta, Diptera, and Ephemeroptera, were from the tailwater.

1263 **(DP—1638) Numerical modeling of ground-water flow at Savannah River Plant.** Root, R.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1983. Contract AC09-76SR00001. 26p. NTIS, PC A03/MF A01. Order Number DE84002443.

The Savannah River Plant is a Department of Energy facility operated primarily to produce nuclear materials for national defense. Solid low-level radioactive waste generated during plant operations is buried in trenches in specific areas designated for this purpose. A three-dimensional finite-difference numerical model has been developed to study the ground-water flow system in the saturated zone underlying these waste burial areas. A steady-state flow model has been calibrated and indicates that the average horizontal hydraulic conductivity of the underlying water-bearing formations is 1.8 meters per day (5.9 feet per day). Given the hydraulic gradients in the area, flow velocities in the range of 10 to 22 meters per day (30 to 70 ft per year) were calculated and are generally supported by aquifer pumping and tracer tests. 8 references, 12 figures.

1264 **(DP-MS—83-101) Recreational activity on the Savannah River.** Hutto, G.A.; Turcotte, M.D.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 29 Sep 1983. Contract AC09-76SR00001. 14p. NTIS, PC A02/MF A01. Order Number DE84001935.

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Recreational data available from the Georgia Department of Natural Resources were statistically expanded to obtain estimates of recreational use of the Savannah River for comparison with the estimates suggested by NRC. (ACR)

1265 **(DPST—83-738) Savannah River Aquatic Ecology Program. Preliminary 1983 report.** O'Hara, J.; Specht, W.; Osteen, V. (Environmental Chemical Sciences, Inc., Aiken, SC (USA)). Aug 1983. Contract AC09-76SR00001. 76p. (ECS-SR—5). NTIS, PC A05/MF A01. Order Number DE84001117.

The program was designed to provide data on the biological communities in the Savannah River that might be directly affected by the present and proposed activities of the Savannah River Plant (SRP). One of the major activities to be evaluated for potential impact is the restart of the L-Reactor. This report presents data on ichthyoplankton abundance, removal of ichthyoplankton through entrainment with the cooling water and the impingement of fishes on the screens that protect the intake pumps.

1266 **(DPST—83-754) Biological assessment for the shortnose sturgeon, Acipenser brevirostrum Lesueur 1818, the Savannah River Plant.** Muska, C.; Matthews, R.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1983. Contract AC09-76SR00001. 72p. NTIS, PC A04/MF A01. Order Number DE84002433.

The shortnose sturgeon (Acipenser brevirostrum) is listed as an endangered species in the United States. Prior to 1982, the presence of shortnose sturgeon had not been documented in the middle reaches of the Savannah River. However, shortnose sturgeon larvae were collected in 1982-1983 near the Savannah River Plant (SRP), a US Department of Energy (DOE) facility, as part of the SRP aquatic ecology program. This biological assessment was prepared to evaluate the potential impacts of present and proposed SRP operations on the shortnose sturgeon. This assessment is based on existing information on the life history and habitat preferences of the shortnose sturgeon, a description of the Savannah River Plant including plant operations which may potentially impact the shortnose sturgeon and consultations with local experts. From this information, it is concluded that the existing and proposed operations (specifically L-Reactor operation) of the Savannah River Plant will not affect the continued existence of the shortnose sturgeon the Savannah River.

1267 **(FWS/OBS—82/60-Vol.1) Energy-related use conflicts for the Columbia River Estuary. Volume I. Text.** Garcia, J.; Loehr, L.; Richter, K.; Ahlborn, G.; Westerlund, F.; Pratt, J. (BioSystems Analysis, Inc., Sausalito, CA (USA)). Jun 1983. 500p. NTIS, PC A21/MF A01. Order Number DE84900176.

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High, medium, and low probabilities of energy related development are projected for the Columbia River Estuary to river mile 93. Projections for five, fifteen, and twenty-five year planning horizons are aggregated, mapped, and described. The direct and indirect effects of projected energy-related development upon fish and wildlife in estuarine and riverine systems are summarized. Habitats affected by construction are identified, and operations of energy facility components causing impacts are characterized. Ecosystem models are developed for riverine, estuarine, channel, sandflat, mudflat, emergent vegetation, and riparian habitats to determine biological significance and pathways of projected impacts. Species accounts are furnished for 13 species and species groups that are of special concern. Cumulative impacts are integrated and described on a site-specific basis. Policy-making, planning, and regulatory processes relevant to the control of energy-related impacts in the Columbia River Estuary and lower river are outlined. Management and mitigation measures are discussed both for species of concern and for the types of energy facilities expected to be developed. This report has two volumes. Volume 1 provides a narrative description of projected energy development and describes the biological characteristics of fish and wildlife and their habitats, and gives a critique of potential environmental impacts, and measures of protection and mitigation.

1268 **(FWS/OBS—82/60-Vol.2) Energy-related use conflicts for the Columbia River Estuary. Volume II (atlas).** Garcia, J. (Fish and Wildlife Service, Slidell, LA (USA). National Coastal Ecosystems Team). Jun 1983. 137p. NTIS, PC A07/MF A01. Order Number DE84900170.

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This volume consists of 3 overviews, an index to the quadrants, and a series of 11 scenario maps that forecast energy related developments of the Lower Columbia River and Estuary from 1981 to 2006. These scenarios are based largely on forecasts prepared by the Bonneville Power Administration, Northwest Energy Policy Project, Pacific Northwest Utilities Conference Committee, and the Natural Resources Defense Council, all of which are regional in scope. Siting options were evaluated partly on the basis of the biological values of the estuary. Analyses were based on interviews with governmental agencies, public utility and energy supply companies, port authorities, reviews of published documents, feasibility studies, Coastal Zone Management plans, and products of similar planning agencies. After evaluation, facilities were assigned sites, levels of probabilities, and time frames. Scenarios at different levels (low, medium, and high) of development were prepared for 5 to 10 year increments, i.e., 1981-1986, 1987-1996, and 1997-2006.

1269 **(PNL—4845) Littoral processes: US Coast Guard Station, Fort Point, San Francisco.** Ecker, R.M.; Whelan, G. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 90p. NTIS, PC A05/MF A01. Order Number DE84001639.

The US Coast Guard Station, Fort Point is located three-quarters of a nautical mile southeast of the Golden Gate Strait, the entrance to San Francisco Bay. The existing storm wave conditions at Fort Point Station pier make it extremely dangerous for the SAR crews to get on and off the Motor Life Boats at times requiring the vessels to be moored at the San Francisco Yacht Harbor about 1.5 miles east of the Fort Point Station. To mitigate these harsh working conditions the US Coast Guard is considering the feasibility of constructing suitable all-weather moorings for the three Motor Life Boats at the Fort Point Station to enable unimpeded SAR operations, to provide safe working conditions for Coast Guard small boat crews, and to improve small boat maintenance conditions at Fort Point Station. The purpose of this report is to identify, analyze and evaluate physical environmental factors that could affect all-weather moorings siting, configuration and entrance location, as well as potential post construction alterations to littoral conditions and processes. This report includes a description of the site, description of pertinent littoral processes, evaluation of how these processes could affect construction of all-weather moorings, and discussion of design considerations, as well as mitigation measures to minimize potential adverse effects to the physical environment. 19 references, 27 figures, 26 tables.

5206 Regulations

REFER ALSO TO CITATION(S) 631

1270 **(ORNL—5942) Evaluation of OECD guidelines for testing of chemicals with aquatic organisms.** Blaylock, B.G.; McCarthy, J.F.; Frank, M.L.; Singley, P.T. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 178p. NTIS, PC A09/MF A01. Order Number DE84002258.

The protocols in the OECD (Organization for Economic Cooperation and Development) guidelines for testing of chemicals with aquatic organisms were evaluated for the following tests: (1) Fish, Acute Toxicity Test, (2) Bioaccumulation: Flow-through Fish Test, (3) Daphnia sp., 14-day Reproduction Test (including an Acute Immobilization Test), and (4) Alga, Growth Inhibition Test. The protocols were evaluated by conducting the tests with different classes of chemicals (i.e., water soluble, less water soluble requiring a chemical carrier, and volatile chemical). Flow-through and semistatic Fish, Acute Toxicity Tests were conducted with cupric chloride and acridine. The Bioaccumulation Flow-Through Fish Test was conducted with naphthalene and DDE. Three chemicals - cupric chloride, acridine, and di-n-butyl phthalate - were used to evaluate the Daphnia sp., 14-day Reproduction Test. The Alga, Growth Inhibition Test was evaluated with three chemicals: cupric chloride, acridine, and paradichlorobenzene. By following the OECD guidelines in conducting these tests, results were obtained that are comparable with literature data obtained with other methods. An evaluation of each test protocol is given with recommendations for the guidelines for conducting the tests.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 283

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 257, 622, 623, 1352

1271 **(DOE/CA/10012—T1) Summary of women's testimony on National Energy Plan III.** Logan, P.; Hopkins, J.; Petkas, M. (Federation of Organizations for Professional Women, Washington, DC (USA)). [nd]. Contract FG01-81CA10012. 37p. NTIS, PC A03/MF A01. Order Number DE84000935.

The one characteristic that predominated in the comments of nearly every woman who testified was the ability - in fact, the need - to make connections. Overwhelmingly, the women emphasized and elaborated on the complexities of energy policy and energy issues, and they saw the problems in more than simply technological terms as they struggled toward solutions that integrated human and social concerns with technology. Perhaps because of their unique position in society the women had a different perspective. Most women agreed that it is the American people themselves who will solve our energy problems, but they qualified their comments carefully. While many women emphasized that people themselves are a resource and that people working locally could best recognize, develop, and efficiently use their own energy resources, they added that the people alone do not bear the whole burden of energy problems and solutions. The women repeatedly pointed to the role of the federal government in providing the country - through wise decision-making and citizen education - with an energy policy that leads us to a sane and sustainable future. They recognized that this change in policy must be connected with a change in attitude because the choices are value laden, and will affect the entire texture of our national life. Many claimed that while NEP-III should construct a bridge to our future and provide a quick and smooth transition, it does not. Far and away, the women recommended an emphasis on conservation and renewable fuels.

1272 **(DOE/NBM—4001405) Energy use: the human dimension.** Stern, P.; Aronson, E. (eds.). (National Research Council, Washington, DC (USA). Committee on Behavioral and Social Aspects of Energy Consumption and Production). Mar 1983. 347p. NTIS, PC A15/MF A01. Order Number DE84001405.

Issues considered as among the most important facing society were: the nature and determinants of energy consumption; prevention, preparation, and response for energy emergencies; and plans for meeting energy needs at the local level. A range of factors that influence individual and social behavior was analyzed in hopes of incorporating the human dimension into energy policy. Energy aspects in modern society encompass simultaneously a commodity, an ecological resource, a social necessity, and a collection of strategic materials but citizens view these one at a time. Potential for improved efficiency of energy use is reviewed.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 1258

1273 **(TVA/PUB—83/44) Draft environmental impact statement: Marquez Uranium Project, McKinley County, New Mexico.** (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources). 1983. 212p. NTIS, PC A10/MF A01. Order Number DE84900277.

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TVA has proposed to underground mine, through its operator, the uranium deposits located in the Canon de Marquez in McKinley County, New Mexico. Construction and operation of the underground mine would be expected to have the following environmental effects: (1) a temporary change in land use for 48.5 hectares (120 acres) from wildlife habitat and recreation to mineral extraction; (2) a minor alteration in topography near the proposed pond sites due to reclamation of waste rock piles; (3) minimal impacts on land due to limited vehicular traffic and road construction; (4) temporary depression of ground water levels in the Westwater Canyon Member of the Morrison Formation in the mine vicinity during mine life; (5) short-term project-induced impacts to surface water and shallow ground water quality; (6) a temporary decrease in air quality in the vicinity of the mining operations due to fugitive dust and exhaust emissions from combustion-driven mining and support vehicles and releases of radon and short-lived radon progeny from ventilation shafts and ore piles; (7) a temporary decrease of plant and animal species at the mine site; (8) a minor and temporary effect on aquatic systems downstream from the mine and settling ponds due to sedimentation; and (9) a minor increase of noise levels in the immediate vicinity of mine shafts and vents.

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 520

1274 **(PB—83-234153) Supplemental final environmental impact statement Dolet Hills lignite mine project De Soto parish, Louisiana (a supplement to the Dolet Hills power plant eis).** (Environmental Protection Agency, Dallas, TX (USA). Region VI). Jul 1983. 285p. (EPA—906/9-83-007). NTIS, PC A13/MF A01.

The Supplemental Final Environmental Impact Statement (SFEIS) was prepared as part of the 'tiering' concept, and is intended to supplement the Dolet Hills Power Plant Project Draft EIS and Final EIS in which Southwestern Electric Power Company (SWEPCO) and Central Louisiana Electric Company, Inc. (CLECO) evaluated alternative power plant designs and mine-mouth siting options around a 211.1 million ton lignite reserve. The Dolet Hills Mining Venture (DHMV) proposes to construct and operate a 29,573 acre surface lignite mine and related ancillary facilities. EPA is considering the issuance or denial of a New Source NPDES permit for the alternatives evaluated, including no action. The SFEIS documents coordination activities since the supplemental draft EIS, includes revisions in response to comments, and presents EPA's and DHMV's preferred alternatives.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

1275 **Age and sex selectivity in trapping mule deer.** Garrott, R.A.; White, G.C. (Los Alamos National Lab., NM). *Journal of Wildlife Management;* **46**: No. 4, 1083-1086(1982). Contract W-7405-ENG-36.

A mule deer (Odocoileus hemionus) trapping experiment is described using modified Clover traps in which changes in the placement of bait and height of the trap door modified the ratio of adult does to male and female fawns captured. The mechanisms responsible for the changes in age-sex capture ratios are discussed and indicate that modified Clover traps selectivity capture mule deer, thus introducing bias into population sampling. (JMT)

5502 Biochemistry

REFER ALSO TO CITATION(S) 950, 1294, 1339, 1340, 1341, 1347

1276 **(BNL—33729) Chlorobium aminolipid: a new membrane lipid from green sulfur bacteria.** Olson, J.M.; Shaw, E.K.; Gaffney, J.S.; Scandella, C.J. (Brookhaven National Lab., Upton, NY (USA); Odense Univ. (Denmark); Genex Corp., Gaithersburg, MD (USA)). 1983. Contract AC02-76CH00016. 5p. (CONF-8308110—6). NTIS, PC A02/MF A01. Order Number DE84001897.

From 6. international congress on photosynthesis; Brussels, Belgium (1 Aug 1983).

A preliminary chemical characterization of the aminolipid from Chlorobium limicola f. thiosulfatophilum shows that this lipid contains no phosphorus, glycerol, sugar, ornithine or lysine. The lipid has an R/sub f/-value of 0.03 in chloroform-methanol-ammonia (13:5:1 v/v) on silica gel TLC plates. In chloroform-methanol-water (65:25:4) the R/sub f/- value is 0.16. The absorption spectrum indicates bands at 225 and 231 nm, and the fluorescence (maximum emission at 340 nm) shows excitation maxima at 232, 288, and ~ 325 nm. Acid hydrolysis of the lipid yields fluorescent substances A (ninhydrin positive) and B (negative) in addition to myristic acid (C 14:0). The fluorescence emission and excitation spectra of substance A are very similar to those of the intact lipid. Although these excitation spectra resemble the absorption spectra of 7,8-dihydropterins (bands at ~ 230, ~ 280, and 320-330 nm at pH 7), the weight of evidence appears to be against substance A being a pterin. Nevertheless the UV absorption and fluorescence spectra do indicate that the amino moiety (substance A) is an aromatic heterocyclic component.

1277 **(CONF-8209179—1) Resistance to lipid peroxidation by cultured neoplastic cells.** Arneson, R.M.; Wander, J.D.; Cabot, M.C.; Tan, E.L.; Schenley, R.L.; Hsie, A.W. (Georgia Univ., Athens (USA). Dept. of Physics; Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE84000206.

From 2. National Foundation for Cancer Research symposium on protective agents in humans and experimental cancers; Uxbridge, UK (1 Sep 1982).

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The membranes of murine neuroblastoma cells (C1300) and human leukemia cells (HL-60) exhibit markedly increased resistance to peroxidation and undifferentiated Friend erythroleukemia cells were highly resistant to peroxidation. These findings suggest that high resistance to peroxidation and changes in the level of resistance occur commonly in cultured cells. Both cytosolic and membrane-associated factors that can prevent the onset of lipid peroxidation are present in differentiating neuroblastoma cells. A highly sensitive, single-phase assay for antioxidant activity failed to detect the presence of an antioxidant that could be associated with increased resistance to peroxidation in neuroblastoma cells. Likewise, lipid analyses of neuroblastoma cells revealed no parameter that could be related to this increase; however, this resistance phenomenon is abolished by adding arachidonic acid to the culture medium at levels that do not affect cell growth or viability. Protective factors exist in the cytosolic fraction of rat liver homogenate, which are able to neutralize the toxic products of lipid peroxidation rather than prevent the initiation of peroxidation. These protective factors were detected, and could possibly be isolated, by a cytotoxicity assay employing Chinese hamster ovary cells. In the course of this work, we discovered an antioxidant artifact that is widely distributed in commercial tissue culture media. A simple procedure has been developed to detect this antioxidant in lots of culture media.

1278 **(DOE/EV/02040—15) Insertion of nucleotides opposite AP (apurinic/apyrimidinic) sites in DNA during in vitro synthesis: the uniqueness of adenine nucleotides.** Sagher, D.; Strauss, B. (Chicago Univ., IL (USA). Dept. of Microbiology). [nd]. Contract AC02-76EV02040. 34p. NTIS, PC A03/MF A01. Order Number DE84001269.

M13 DNA containing 20 to 30 AP (apurinic/apyrimidinic) sites per intact circular modecule was prepared by growing phage on an ung⁻ dut⁻ E. coli mutant and treating the DNA with uracil-N-glycosylase. AP sites obstruct in vitro DNA synthesis catalyzed by E. coli pol I. The position at which termination of synthesis occurs was determined for four enzymes. T4 DNA polymerase terminates one nucleotide before putative AP sites. DNA pol I, AMV reverse transcriptase and DNA polymerase alpha terminate synthesis either before or at the site of an AP lesion depending on the particular sequence. We determine the identity of the nucleotide inserted opposite AP site by synthesizing up to the lesion in a first stage reaction using T4 DNA polymerase and then determining elongation in a second stage. Purines are inserted opposite AP sites more readily than pyrimidines and dATP is more efficient than dGTP in promoting such elongation. The DNA-dependent conversion of dNTP to dNMP was determined in mixtures of all four dNTP's using AP DNA. The production of dAMP from dATP occurs most readily. We conclude that there is an inherent specificity for the incorporation of A opposite AP sites in this in vitro system. Insofar as the model system reflects in vivo mutational events, our data suggest that depurination should produce transversions and depyrimidination, transitions.

1279 **(LA-UR—83-2252) Nonlinear dynamics of globular proteins.** Lomdahl, P.S. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-830697—3). NTIS, PC A02/MF A01. Order Number DE83015219.

From International conference on nonlinear electrodynamics in biological systems; Loma Linda, CA, USA (5 Jun 1983).

Some ongoing work aimed at generalizing DAVYDOV's ideas to a real globular protein is described. So far, a computer code, GLOP, which calculates amide-I bond energy evolution on a globular protein has been developed and tested. The code is quite

versatile and takes as input the coordinates of a protein. The full geometry of the molecule is then taken into account when the dipole-dipole interaction between peptide groups is calculated. The amide-I energy is coupled to one intramolecular excitation, but can without difficulty be extended to more or to include intermolecular excitations.

1280 **(LBL—16446) Carboxyl groups and the proton pump of bacteriorhodopsin.** Herz, J.M.; Packer, L. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 17p. (CONF-8309178—1). NTIS, PC A02/MF A01. Order Number DE84001329.

From Conference on transport of proteins, ions and electrons through mitochondrial membranes; University College Cork, Ireland (27 Sep 1983).

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Chemical modification and spin-labeled studies of purple membranes isolated from Halobacterium halobium have provided the first evidence for buried carboxyl residues within the hydrophobic, membrane-protein domains. Spin label data showed that modification of buried carboxyl residues resulted in loss of protein activity. A pH-sensitive, chromophoric reporter group demostrated that a carboxyl residue in a hydrophobic membrane environment interacts with the retinal chromophore of bacteriorhodopsin. These results appear consistent with the idea that carboxyl residues in hydrophobic environments may be a general feature required for activity of membrane proton pumps.

1281 **Chlorophyllide-substituted hemoglobin tetramers and hybrids: preparation, characterization, and energy transfer.** Kuki, A.; Boxer, S.G. (Stanford University, CA). *Biochemistry;* **22**: No. 12, 2923-2933(7 Jun 1983). Contract FG02-80CS84006.

Three chlorophyllide-substituted human hemoglobin (Hb) complexes have been prepared: the tetrameric complex in which zinc pyrochlorophyllide a (ZnPChla) is substituted for all four hemes and the two complementary hybrids in which ZnPChla is substituted for heme in either the α- or β-chains, while heme remains in the other chains. In each of these complexes, intramolecular Chl-Chl singlet energy transfer occurs. A variety of probes demonstrate that ZnPChla-deoxyheme hybrids and the ZnPChla-Hb complexes consistently exhibit properties associated with the well-known T-state tertiary and quaternary structure of deoxyHb itself. Using the known crystal structure of human deoxyHb, we have analyzed the steady-state fluorescnce anisotropy of these complexes within the framework of the Forster energy-transfer theory. The result is the determination of the orientation of the Q/sub y/ transition dipole moment of ZnPChla. Nuclear magnetic resonance data for the hybrids offer insight into specific tertiary structure changes in the heme pocket surrounding the diamagnetic ZnPChla, which accompany changes in the ligation state of the heme on the opposite chain.

1282 **Differential radiolabeling of opposite microtubule ends: methodology, equilibrium exchange-flux analysis, and drug poisoning.** Jordan, M.A.; Farrell, K.W. (Univ. of California, Santa Barbara). *Analytical Biochemistry;* **130**: No. 1, 41-53(1 Apr 1983).

We describe a method which allows opposite microtubule ends to be distinguished by differentially labeling the microtubules with [^{3}H]- and [^{14}C]guanine nucleotides. Assembly-disassembly reaction at opposite microtubule ends can therefore be measured simultaneously and without modification of the tubulin dimers or microtubules. The method is predicated on experimental observations wich demonstated that net dimer addition to steady-state microtubules mst be predominantly unidirectional. This does not preclude, however, some bidirectional dimer addition to steady-state microtubules by an equilibrium-exchange mechanism. We therefore calculated the relative contribution to dimer incorporation of bidirectional equilibrium exchange in a unidirectional microtubule system (s=0.06). Under our conditions bidirectional dimer incorporation is negligible; net dimer additional to steady-state microtubules is overwhelmingly unidirectional. We used this method to study the effects of colchicine and podophyllotoxin on assembly-disassembly at opposite microtubule ends. Both drugs inhibit substoichiometrically net dimer addition to one microtubule end and, to a lesser extent, net dimer loss from the opposite end.

1283 **Sequential assignments for the ^{1}H and ^{31}P atoms in the backbone of oligonucleotides by two-dimensional nuclear magnetic resonance.** Pardi, A. (Eidgenossiche Technische Hochschule, Zurich, Switzerland); Walker, R.; Rapoport, H.; Wider, G.; Wuthrich, K. *Journal of the American Chemical Society;* **105**: No. 6, 1652-1653(23 Mar 1983).

A novel application of two-dimensional nuclear magnetic resonance (2-D NMR) for assignment of hydrogen and phosphorus nuclei in the sugar phosphate backbone of oligonucleotides is described and illustrated by the assignment of the tetranuclrotide d-CpTpApG. The assignments are made by observation of homonuclear (^{1}H-^{1}H) and heteronuclear (^{1}H-^{31}P) scalar spin-spin couplings.

1284 **In vitro bypass of UV-induced lesions by Escherichia coli DNA polymerase I: specificity of nucleotide incorporation.** Rabkin, S.D.; Moore, P.D.; Strauss, B.D. (University of Chicago, IL). *Proceedings of the National Academy of Sciences of the United States of America;* **80**: No. 6, 1541-1545(Mar 1983). Contract AC02-76EV02040.

A variety of DNA polymerases, synthesizing in vitro on an UV-irradiated phiX174 DNA template, terminate synthesis one nucleotide before the 3′ pyrimidines of putative dimers on the template. We have devised a system using Escherichia coli DNA polymerase I (Klenow fragment) that can synthesize past at least some of these dimers. The bypass is carried out in a multistep process--first, the incorporation of nucleotides opposite the pyrimidines in the dimer and, then, the addition of nucleotides complementary to the bases distal to the dimer. The insertion of a nucleotide opposite the first (3′) pryimidine of a putative dimer in the presence of Mn^{2+} occurs in a concentration-dependent fashion with a 3- to 4-fold preference for purine nucleotides over pyrimidine nucleotides. In the presence of Mg^{2+}, insertion is less frequent. Correlation of these results with in vivo mutation data suggests a role for the polymerase in determining the spectrum of base substitution mutagenesis in SOS induced cells.

1285 **Quantitation of pyrimidine dimer contents of nonradioactive deoxyribonucleic acid by electrophoresis in alkaline agarose gels.** Sutherland, B.M.; Shih, A.G. (Brookhaven National Lab., Upton, NY). *Biochemistry;* **22**: No. 4, 745-749(15 Feb 1983).

We have developed a method of quantitating the pyrimidine dimer content of nonradioactive DNAs. DNA samples are treated with the UV-endonuclease from Micrococcus luteus and then separated according to molecular weight by electrophoresis on alkaline agarose gels. From their migration relative to known molecular weight standards, their median molecular weight and thus the number of dimers per DNA molecule in each sample can be calculated. Results of action spectra for dimer formation in T7 bacteriophage measured by this method agree well with action spectra for T7 killing. In addition, the method gives dimer yields in good agreement with those obtained by others using alkaline sucrose gradient sedimentation.

1286 **Facile oxygen exchanges of phosphoenolpyruvate and preparation of [^{18}O]phosphoenolpyruvate.** O'Neal, C.C. Jr.; Bild, G.S.; Smith, L.T. (University of California, Los Angeles). *Biochemistry;* **22**: No. 3, 611-617(1 Feb 1983). Contract AT03-76ER70102.

Phosphoenolpyruvate when heated in acidic solution exchanges its phosphoryl and carboxyl oxygens rapidly and its enolic oxygen much more slowly with oxygens from water. The incorporation of ^{18}O into phosphoenolpyruvate was measured by gas chromatography-mass spectrometry and phosphorus-31 nuclear magnetic resonance after heating in $H_2{}^{18}O$ at 98°C. The rates of exchange of all six oxygens of phosphoenolpyruvate with water increase with increasing acidity, and the phosphoryl oxygens exchange more rapidly than the carboxyl oxygens. The rate of exchange of each oxygen of the phosphoryl group is 16-fold greater than the hydrolysis rate at 1 N HCl. This provides a simple and useful method for the synthesis of [^{18}O]phosphoenolpyruvate highly enriched in its phosphoryl-group oxygens. An enrichment of 89% was obtained with a 50% yield. The [^{18}O]phosphoenolpyruvate showed a binomial distribution of ^{18}O in the phosphoryl-group oxygens. The

exchange may be explained by the reversible formation of a transient cyclic phosphate and, for exchange of the enolic oxygen, a transient acyl phosphate. Preparation of [^{18}O]phospheonolpyruvate from [^{18}O]P/sub i/ by a chemical synthesis from β-chlorolactate was not satisfactory because of drastic loss of ^{18}O also occurred during an enzymic synthesis with KCNO, [^{18}O]P/sub i/, carbamate kinase, and pyruvate kinase.

1287 **Procedure for rapid isolation of photosynthetic reaction centers using cytochrome c affinity chromatography.** Brudvig, G.W.; Worland, S.T.; Sauer, K. (Lawrence Berkeley Laboratory, CA). *Proceedings of the National Academy of Sciences of the United States of America;* **80**: No. 3, 683-686(Feb 1983). Contract AC03-76SF00098.

Horse heart cytochrome c linked to Sepharose 4B is used to purify reaction centers from Rhodopseudomonas sphaeroides R-26. This procedure allows for an initial recovery of 80-90% of the bacterial reaction centers present in chromatophore membranes. High purity reaction centers ($A_{280}/A_{802} < 1.30$) can be obtained with a 30% recovery. Reaction centers from wild-type Rps. sphaeroides and Rps. capsulata also bind to a cytochrome c column. Cytochrome c affinity chromatography can also be used to isolate photosystem I complexes from spinach chloroplasts.

1288 **Time-resolved chromophore resonance Raman and protein fluorescence of intermediates in some photobiological changes.** El-Sayd, M.A. (University of California, Los Angeles). pp 1-10 of Trends in photobiology. Helene, C.; Charlier, M.; Montenay-Garestier, T.; Laustriat, G. New York, NY; Plenum Publishing Corporation (1982). Contract AT03-76ER70278.

Different resonance Raman techniques are described which are useful in studying intermediates of photolabile systems in the millisecond, microsecond, nanosecond, and picosecond time domains. These techniques are used to study two important photobiological systems: bacteriorhodopsin (bR) and carbonmonoxyhemoglobin (HbCO). The summary of the results of applying these techniques to study the retinal system in bR is given and discussed in terms of what is known about its photochemical proton pump cycle. (JMT)

1289 **The chemical mimicking of the mechanical stimulation, photoinhibition, and recovery from photoinhibition of bioluminescence in the marine dinoflagellate, Gonyaulax polyedra.** Hamman, J.P.; Seliger, H.H. (Johns Hopkins University, Baltimore, MD). *Journal of Cellular Physiology;* **111**: 315-319(1982). Contract AC02-76EV03277.

Mechanically stimulable bioluminescence and photoinhibition of sensitivity to mechanical stimulation in the marine dinoflagellate Gonyaulax polyedra can be mimicked by a number of cations, proportional to the logarithm of their external concentrations. The data are consistent with mechanical stimulability as a membrane depolarization resulting in an increase in H^+ ions at bioluminescence sites and with photoinhibition as a hyperpolarization of the cell membrane.

5503 Cytology

REFER ALSO TO CITATION(S) 1326

1290 **(UCRL—89918) Cytometry of mammalian sperm.** Gledhill, B.L. (Lawrence Livermore National Lab., CA (USA)). 11 Oct 1983. Contract W-7405-ENG-48. 18p. (CONF-8310197—1). NTIS, PC A02/MF A01. Order Number DE84001763.

From DOE reproductive toxicology workshop; San Francisco, CA, USA (12 Oct 1983).

Male germ cells respond dramatically to a variety of insults and are important reproductive dosimeters. Semen analyses are very useful in studies on the effects of drugs, chemicals, and environmental hazards on testicular function, male fertility and heritable germinal mutations. The accessibility of male cells makes them well suited for analytical cytology. We might automate the process of determining sperm morphology but should not do so solely for increased speed. Rather, richer tangible benefits will derive from cytometric evaluation through increased sensitivity, reduced subjectivity, standardization between investigators and laboratories, enhanced archival systems, and the benefits of easily exchanged standardized data. Inroads on the standardization of assays for motility and functional integrity are being made. Flow cytometric analysis of total DNA content of individual sperm is an insensitive means to detect exposure to reproductive toxins because of the small size and low frequency of the DNA content errors. Flow cytometry can be applied to determine the proportions of X- and Y-sperm in semen samples.

5504 Genetics

1291 **Identification of base mismatches recognized by the heteroduplex-DNA-repair system of Streptococcus pneumoniae.** Lacks, S.A.; Dunn, J.J.; Greenberg, B. (Brookhaven National Lab., Upton, NY). *Cell;* **31**: 327-336(Dec 1982).

The susceptibility to repair of particular base mismatches by the hex system of Streptococcus pneumoniae was examined by comparison of the nucleotide sequence of the wild-type and eight mutant alleles of the malM gene. A detailed restriction map was constructed for pLS70, and the nucleotide sequence was determined for its 3475 bp chromosomal insert, which contains the entire malM gene (encoding amylomaltase), portions of malX and malP (encoding a membrane protein and a phosphorylase, respectively) and a control region. Transition mismatches were highly susceptible to repair; transversion mismatches, much less so. A mismatch caused by a single-nucleotide deletion was reparable but mismatches with longer deletions were not. The hex system also reduced spontaneous reversion of mutations corresponding to transitions. It is suggested that recognition of donor or nascent DNA strands by the hex system depends on single-strand breaks in the target strand, and that the role of DNA methylation in mismatch repair of Escherichia coli can be accommodated to this model.

1292 **Mutations altering initiation of translation of yeast iso-1-cytochrome c; contrasts between the eukaryotic and prokaryotic initiation process.** Sherman, F.; Stewart, J.W. (University of Rochester School of Medicine and Dentistry, NY). pp 301-331 of Molecular biology of the yeast Saccharomyces: metabolism and gene expression. Cold Spring, NY; Cold Spring Harbor Laboratory (1982). Contract AC02-76EV03490.

A systematic analysis of mutational alterations at the end of the CYC1 gene in the yeast Saccharomyces cerevisiae has revealed the nucleotide sequences that effect initiation of translation. The analysis of these findings suggest that certain essential features of the translational process may be fundamentally different from the analogous features in Escherichia coli. Furthermore, it is suggested that these differences between yeast and E. coli reflect differences between eukaryotes and prokaryotes. These findings and conclusions concerning the initiation process are briefly reviewed in the paper.

1293 **Suppression in the yeast Saccharomyces cerevisiae.** Sherman, F. (University of Rochester School of Medicine and Dentistry, NY). pp 463-486 of Molecular biology of the yeast Saccharomyces: metabolism and gene expression. Cold Spring, NY; Cold Spring Harbor Laboratory (1982). Contract AC02-76EV03490.

In the brief review, the suppressors of the yeast Saccharomyces cerevisiae are tabulated, and their properties are summarized. The chromosomal map positions of many of the suppressors are presented on a genetic map. (JMT)

5505 Metabolism

REFER ALSO TO CITATION(S) 1225

1294 **(DOE/ER/12027—1) Regulation of terpene metabolism. Progress report.** Croteau, R. (Washington State Univ., Pullman (USA)). 1983. Contract AT06-82ER12027. 9p. NTIS, PC A02/MF A01. Order Number DE84001171.

Portions are illegible in microfiche products.

Progress is reported in the following research areas: function of monoterpene catabolism; pathways and enzymes of monoterpene catabolism; ultrastructure of oil glands; pathways and enzymes of monoterpene biosynthesis; and regulation of metabolism in peppermints. (ACR)

1295 **Isolation and characterization of two new bacteriochlorophylls d bearing neopentyl substituents.** Smith, K.M.; Goff, D.A. (Univ. of California, Davis). *Journal of the American Chemical Society;* **105**: No. 6, 1674-1676(23 Mar 1983). Contract AC02-76CH00016.

The isolation and characterization of two new pigments of Chlorobium vibrioforme forma thiosulfatophilum (NCIB No. 8327) are described. The new bacteriochlorophylls possess a neopentyl substituent at position 4, and the S stereochemistry at the 2-(1-hydroxyethyl) group.

5506 Medicine

REFER ALSO TO CITATION(S) 961

1296 **(DOE/EV/10650—3) Labeling of receptor ligands with bromine radionuclides. Progress report, March 1, 1981-February 29, 1984.** Welch, M.J. (Washington Univ., St. Louis, MO (USA). Edward Mallinckrodt Inst. of Radiology). Oct 1983. Contract AC02-81EV10650. 24p. NTIS, PC A02/MF A01. Order Number DE84001827.

We have developed techniques to label several types of organic molecules with radiobromine. We have emphasized techniques to label ligands for the estrogen receptor and have studied two brominated compounds in rat models. One of these compounds has been studied in a limited number of patients and estrogen containing tumors visualized by nuclear medicine imaging. We have recently expanded the size of the work to label receptor ligands with fluorine-18 and have carried out preliminary animal studies which suggest that a clinically useful compound can be prepared. In addition to the receptor studies, we have collaborated in assessing ^{77}Br-labeled compounds as therapeutic agents and in studying ^{77}Br-labeled compounds using perturbed angular correlation techniques.

1297 **(LBL—14316) Physics of heavy-ion radiography and heavy-ion computerized tomography.** Holley, W.R.; Fabrikant, J.I.; Tobias, C.A.; Benton, E.V. (Lawrence Berkeley Lab., CA (USA); San Francisco Univ., CA (USA). Dept. of Physics). Mar 1982. Contract AC03-76SF00098. 19p. (CONF-820369—2). NTIS, PC A02/MF A01.

From International workshop on physics and engineering in medical imaging; Pacific Grove, CA, USA (15 Mar 1982).

Portions are illegible in microfiche products.

Techniques are being developed at Lawrence Berkeley Laboratory for heavy-ion projection radiography and heavy-ion computerized tomography using high-energy carbon, oxygen and neon beams. The physical characteristics of heavy-ion beams, such as range straggling and multiple Coulomb scattering, affecting image spatial and density resolution and radiation dose are discussed. The methods of beam production and exposure, particle detection, digitization of data, and computer analysis and reconstruction of heavy-ion images are described. Comparisons between heavy-ion CT images and x-ray CT images of phantoms and tissue specimens are made, and the physical bases for differences of the two modalities are discussed.

1298 **(N—8325349) Space physiology and medicine.** Nicogossian, A.E.; Parker J.F. Jr. (National Aeronautics and Space Administration, Washington, DC (USA)). 1982. 331p. (NASA-SP—447). standard NTIS microfiche availability ;HC $15.00/MF A01.

The state of knowledge in space physiology and medicine are reviewed. Overviews of manned space flight, the space environment, spaceflight systems and procedures, physiological adaptation to space flight, health maintenance of space crew members, and medical problems of space flight are presented.

1299 **(ORNL/TM—8827) Nuclear-medicine progress report for quarter ending June 30, 1983.** Knapp, F.F. Jr.; Ambrose, K.R.; Butler, T.A.; Goodman, M.M.; Srivastava, P.C. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE84000346.

Studies with several recently developed ^{123}-I-labeled fatty acids are described. Well defined planar images have been obtained in a dog study utilizing (E)-18-[^{123}I]iodo-17-octadecenoic acid, a new alkenoic fatty acid containing the radioiodide stabilized as a vinyl iodide. Studies are now in progress to prepare (E)-18-borono-17-octadecenoic acid as a kit for rapid iodination to prepare the ^{123}I-labeled fatty acid which will allow investigators to radiolabel this agent on site for further preclinical studies. The first single photon tomographic images have been obtained with 15-[^{123}I]iodophenyl-3-(R,S)-methylpentadecanoic acid. This agent was readily obtained from a new kit involving the H^{123}I decomposition of the piperidinyl triazene derivative of 15-(p-aminophenyl)-3-(R,S)-methyl-pentadecanoic acid. The evaluation of this agent and several radioiodinated fatty acids in the in vitro beating rat heart cell system is described. The recent evaluation of radioiodinated phosphonium cations has now been extended to the preparation and testing of (E)-(-1-[^{125}I]iodo-1-penten-5-yl)triphenylarsonium iodide. Several shipments of raidolabeled agents were made to Medical Cooperative investigators, including three shipments of ^{191}Os for further developing and clinical testing of the ^{191}Os//sup 191m/Ir radionuclide generator. In addition, two shipments of cis-dichlorodiammine [/sup 195m/Pt]platinum(II) were made to participants in collaborative programs. Several radiolabeled fatty acids including 15-(p-[^{131}I]iodophenyl-3-(R,S)-methylpentadecanoic acid and 15-(p-[^{131}I]-iodophenyl)-6-tellurapentadecanoic acid were made for collaborative studies investigating the properties of these new agents.

1300 **(PB—83-234930) Studies of waterborne agents of viral gastroenteritis. Final report Feb 79-Feb 81.** Dolin, R. (Vermont Univ., Burlington (USA). Coll. of Medicine). Jul 1983. 39p. NTIS, PC A03/MF A01.

The etiologic agent of a large outbreak of waterborne viral gastroenteritis was detected employing immune electron microscopy (IEM) and a newly developed solid phase radioimmunoassay (RIA). This agent, referred to as the Snow Mountain Agent (SMA), is 27-32 nm. in diameter, has cubic symmetry, and is morphologically similar to, but antigentically distinct from the previously described Norwalk and Hawaii agents. After an incubation period of 18 to 48 hours, the agent is shed in stools of acutely ill individuals for a period of one to five days. Emplcying both IEM and RIA, serum antibody rises were observed in 3/3 naturally occurring cases and in 8/9 cases of experimentally-induced illness in normal volunteers (the studies in normal volunteers had been carried out prior to the initiation of studies supported by this grant). IEM and RIA appeared to be equally sensitive for detection of antibody rises, but the RIA was more sensitive than IEM for the detection of SMA in stool specimens. Preliminary attempts to cultivate the agent in vitro were unsuccessful.

1301 **Image analysis in critical care medicine.** Budinger, T.F. (Univ. of California, Berkeley). *Critical Care Medicine;* **10**: No. 12, 835-840(1982). Contract AC03-76SF00098.

Computer techniques have been developed to image, noninvasively, anatomical structure, vessel blood flow, and physiological and biochemical functions, utilizing a number of physical principles. These devices, though costly, appear to provide sufficient diagnostic benefits to warrant their use in some critical care units. The emergence of x-ray, digital subtraction angiography, ultrasound, emission and nuclear magnetic resonance imaging techniques and their medical application are described. It is shown that the physical variables measured by these techniques are sensitive to disease conditions and, thus, their incorporation in critical care procedures are likely in the future.

1302 **Application of a commercial Sr-82/Rb-82 generator for heart and kidney imaging.** Neirinckx, R.D.; Gennaro, G.; Loberg, M.D.; Kronauge, J. (The Squibb Institute for Medical Research New Brunswick, NJ (USA)); Cochavi, S.; Goldsmith, S.L. (Mount Sinai Medical Center, New York (USA)); O'Brien, H.A. (Los Alamos National Lab., NM (USA)). pp 613-617 of Nuclear medicine and biology. Proceedings Vol. 1. Raynaud, C. (ed.). Paris, France; Pergamon (1982). (CONF-820804—).

From 3. world congress of nuclear medicine and biology; Paris, France (29 Aug 1982).

A comparison was made between two Sr-82/Rb-82 generator systems based on the inorganic adsorbents hydrous SnO_2 and basic Al_2O_3. The SnO_2 based generator was found to be superior because of its lower Sr(II)-breakthrough (10^{-9}/ml) and ease of elution at higher speeds (up to 100 ml/min). It was demonstrated that the use of a multi-crystal camera outfitted with a high-resolution collimator allowed the use of positron emitting isotopes for planar imaging. Rubidium-82 studies of myocardial and renal perfusion are reported, and the ability to detect myocardial perfusion defects using a multi-crystal camera is demonstrated.

1303 **Design and evaluation of radiotracers for determination of regional cerebral blood flow with PET.** Lambrecht, R.M.; Shiue, C.Y. (Brookhaven National Laboratory, Upton, NY (USA)); Duncan, C.C. (Yale University School of Medicine, New Haven, CT (USA)). pp 654-657 of Nuclear medicine and biology. Proceedings Vol. 1. Raynaud, C. (ed.). Paris, France; Pergamon (1982). (CONF-820804—).

From 3. world congress of nuclear medicine and biology; Paris, France (29 Aug 1982).

The tracer kinetics of 4-Fluoro(^{18}F)-, 4-Bromo(^{82}Br)- and 4-Iodo(^{126}I)-antipyrine and ^{15}O-water were compared in a cat or baboon animal model. First pass cerebral extraction and clearance with alteration in $PaCO_2$ were measured for whole brain. The Renkin/Crone model was used to evaluate brain capillary permeability-surface area product for 4-^{18}FAP in cats. Positron emission tomographic measurements required development of an instrument and technique for control of the arterial concentration of the radiotracer as a ramp function, so that tracer concentration changes due to radioactive decay or altered physiological processes could be accurately described with PET. Pharmacokinetic and tissue distribution studies in cats were used to determine dosimetry for 4-^{18}FAP. 4-Bromoantipyrine labeled with ^{76}Br (t=6.5 m) is suggested as a tracer for determination of rCBF with PET.

1304 **Preparation for liver scanning agent labeled with positron emitters, generator produced gallium-68.** Ishioka, K.; Kuniyasu, Y.; Higashi, S.; Kakehi, H. (Teikyo University School of Medicine, Tokyo (Japan)); Hayes, R.L.; Carlton, J.E. (Oak Ridge Associated Universities, TN (USA)). pp 662-665 of Nuclear medicine and biology. Proceedings Vol. 1. Raynaud, C. (ed.). Paris, France; Pergamon (1982). (CONF-820804—).

From 3. world congress of nuclear medicine and biology; Paris, France (29 Aug 1982).

We have developed a preparation of liver scanning agent for emission computed tomography (ECT). For this agent, human serum albumin microspheres labeled with short-lived and generator-produced positron emitters gallium-68 were prepared. We studied on the fundamental and basic research used with Ga-67 which was γ-ray emitting isotope instead of Ga-68, and/or with Ga-68 itself. We investigated elution efficiency of an ion-exchange column, optimium labelling factors (pH, incubation time and temperature), physical and chemical reaction between gallium ion and microspheres labeled with gallium, such as adhesion to glass and other materials, and competition of zinc to gallium. The optimium labelling ratio depended on pH only and the optimum pH was 5.0 to 5.5. Tissue distribution and toxicity studies with this agent were examined using experimental animals. Finally the cross section images of the liver of rabbits and dogs were taken with this scanning agent using positron camera. We got the accurate structure of the liver on the cross section images with this scanning agent (Ga-68 labeled microspheres).

1305 **Changes in body composition of cancer patients following combined nutritional support.** Cohn, S.H.; Vartsky, D.; Vaswani, A.N.; Sawitsky, A.; Rai, K.; Gartenhaus, W.; Yasumura, S.; Ellis, K.J. (Brookhaven National Laboratory, Medical Research Center, Upton, NY). *Nutrition and Cancer;* 4: No. 2, 107-119(1982).

The effects of combined nutritional support (parenteral, enteral, and oral) were measured in cancer patients unable to maintain normal alimentation.Changes in body composition were quantified by measurement of total body levels of nitrogen, potassium, water, and fat. The protein-calorie intake of the patients was also evaluated by dietary survey (4-day recall). Standard anthropometric and biochemical measurements for nutritional assessment were obtained for comparison. The dietary evaluation indicated that the dietary supplementation for all patients was more than adequate to meet their energy requirements. Determination of body composition indicated that change in body weight was equal to the sum of the changes in body protein, total body water, and total body fat. Information on the nature of the tissue gained was obtained by comparison of body composition data with the ratio of protein:water:lean body mass for normal tissue. The mean gain of protein in the cancer patients was quite small (0.3-0.6 kg). The main change in body weight appeared to be the result of gains in body water and body fat. The total body nitrogen to potassium ratio served to define the extent of tissue anabolism following hyperalimentation. The ratio dropped in the cancer patients following hyperalimentation toward the value of the control subjects on ad libitum diets. Total body nitrogen was determined by prompt gamma neutron activation analysis, total body potassium by whole-body counting. (JMT)

1306 **Dynamic positron emission tomography in man using small bismuth germanate crystals.** Derenzo, S.F.; Budinger, T.F.; Huesman, R.H.; Cahoon, J.L. (Lawrence Berkeley Laboratory, CA). pp 935-945 of Positron annihilation. Coleman, P.G.; Sharma, S.C.; Diana, L.M. (eds.). Amsterdam, Netherlands; North-Holland Publishing Company (1982). Contract AC03-76SF00098.

Primary considerations for the design of positron emission tomographs for medical studies in humans are the need for high imaging sensitivity, whole organ coverage, good spatial resolution, high maximum data rates, adequate spatial sampling with minimum mechanical motion, shielding against out of plane activity, pulse height discrimination against scattered photons, and timing discrimination against accidental coincidences. We discuss the choice of detectors, sampling motion, shielding, and electronics to meet these objectives.

5507 Microbiology

REFER ALSO TO CITATION(S) 92, 140, 141, 472, 1276

1307 **(DOE/ER/10874—3) Fatty and aromatic acid catabolizing bacteria from methanogenic ecosystems. Progress report, April 1, 1981-June 30, 1983.** (Illinois Univ., Urbana (USA). Dept. of Microbiology). 1983. Contract AC02-81ER10874. 27p. NTIS, PC A03/MF A01. Order Number DE84001565.

Progress is reported in the following research areas: (1) establishment of strains of Syntrophomonas wolfei and Syntrophomonas buswellii in a recognized culture collection; (2) long-chain fatty acid-degrading Syntrophomonas; and (3) phenolic compound-degrading bacteria. (ACR)

1308 **Microbial fermentative preparation of L-[$^{15}N_2$]lysine and its tracer: application to serum amino acid kinetic studies.** Irving, C.S.; Cooney, C.L.; Brown, L.T.; Gold, D.; Gordon, J.; Klein, P.D. (Baylor College of Medicine, Houston, TX). *Analytical Biochemistry;* 131: No. 1, vp(May 1983). Contract W-31-109-ENG-38.

The microorganism Brevibacterium flavium 21129 has been used to produce multigram batches of L-[$^{15}N_2$]lysine of high purity and isotopic enrichment by supplementation of the growth medium with $(^{15}NH_4)_2SO_4$ of 98.0 atom% excess. The doubly ^{15}N-labeled

lysine can be detected at dilutions 10 times greater than singly labeled lysine when isotope dilution curves are analyzed by gas chromatography-mass spectrometry. This enhanced sensitivity permits kinetic measurements of plasma free-lysine isotope content over a 300-fold dilution during 6 h following a single oral bolus of 5 mg/kg body wt. This inexpensive preparation method lends itself to the production of highly useful biochemical compounds for kinetic studies of human nutrition.

5509 Pathology

REFER ALSO TO CITATION(S) 1323

5510 Physiological Systems

REFER ALSO TO CITATION(S) 960, 1343

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 404

1309 **Height distributions of two species of cacti in relation to rainfall, seedling establishment, and growth.** Jordon, P.W.; Nobel, P.S. (University of California, Los Angeles). *Botanical Gazette (Chicago);* 143: No. 4, 511-517(1982). Contract AC03-76SF00012.

In three populations of Ferocactus acanthodes and two of Carnegiea gigantea, multiple discrete peaks in the height distribution were observed, suggesting that seedling establishment was intermittent. To identify periods of establishment, we determined the relationship between stem height and age for each site, based on observed growth rates in the field, gas-exchange data, and weather records. The average yearly growth for the globular F. acanthodes was relatively constant at about 9 mm yr^{-1}, but for the club-shaped C. gigantea, it increased with age from 2 mm yr^{-1} in the first year to 44 mm yr^{-1} at 13 yr. In years suitable for establishment, seedlings grow to sufficient size that stored water is not depleted by cuticular transpiration during the ensuing drought. The pattern of such suitable years over the last 3 decades correlated with the measured height distributions when the relation between stem height and age was considered. At a Sonoran Desert site, major peaks in the height distribution were centered at 0.05 m and 0.19 m, which corresponded to suitable conditions for establishment in 1976 and 1959, respectively. Rainfall records from various weather stations indicated that both species occurred where at least 10% of the years are suitable for seedling establishment.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 288, 1154, 1216, 1234, 1234, 1290, 1297, 1298, 1376, 1598, 1598, 1598, 1599, 1601

1310 **(AD-A—130332/0) Annual rerearch report on projects of the armed forces Radiobiology Research Institute, 1 October 1979 - 30 September 1980.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 30 Sep 1980. 76p. (AFRRI-ARR—14). NTIS, PC A05/MF A01.

This report contains a summary of the research projects of the Armed Forces Radiobiology Reseach Institute for the period 1 October 1979 through 30 September 1980.

1311 **(BNL—33782) Stochastic, weighted hit size theory of cellular radiobiological action.** Bond, V.P.; Varma, M.N. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 15p. (CONF-820931—14). NTIS, PC A02/MF A01. Order Number DE84001692.

From 8. symposium on microdosimetry; Juelich, F.R. Germany (27 Sep 1982).

Portions are illegible in microfiche products.

A stochastic theory that appears to account well for the observed responses of cell populations exposed in radiation fields of different qualities and for different durations of exposure is described. The theory appears to explain well most cellular radiobiological phenomena observed in at least autonomous cell systems, argues for the use of fluence rate (phi) instead of absorbed dose for quantification of the amount of radiation involved in low level radiation exposure. With or without invoking the cell sensitivity function, the conceptual improvement would be substantial. The approach suggested also shows that the absorbed dose-cell response functions currently employed do not reflect the spectrum of cell sensitivities to increasing cell doses of a single agent, nor can RBE represent the potency ratio for different agents that can produce similar quantal responses. Thus, for accurate comparison of cell sensitivities among different cells in the same individual, or between the cells in different kinds of individuals, it is necessary to quantify cell sensitivity in terms of the hit size weighting or cell sensitivity function introduced here. Similarly, this function should be employed to evaluate the relative potency of radiation and other radiomimetic chemical or physical agents.

1312 **(CONF-830710—10) Early mechanisms in radiation-induced biological damage.** Powers, E.L. (Texas Univ., Austin (USA). Lab. of Radiation Biology). 1983. Contract AS05-76EV03408. 9p. NTIS, PC A02/MF A01. Order Number DE84001511.

From 7. international conference of radiation research; Amsterdam, Netherlands (3 Jul 1983).

An introduction to the mechanisms of radiation action in biological systems is presented. Several questions about the nature of the radiation damage process are discussed, including recognition of the oxygen effects, dose-response relationships, and the importance of the hydroxyl radical. (ACR)

1313 **(DOE/EV/03380—39) Oncogenic action of ionizing radiation on rat skin. Progress report, period ending January 31, 1984.** Burns, F.J. (New York Univ., NY (USA). Medical Center). 1983. Contract AC02-76EV03380. 18p. NTIS, PC A02/MF A01. Order Number DE84001294.

Models of carcinogenesis were tested against experimental data in a well-characterized biological system to establish the plausibility of such models. The model being developed is based on the idea that the geometrical distribution of the initial lesions within the nucleus of the target cell is critical to the biological alteration that predisposes to carcinogenesis. (ACR)

1314 **(DOE/EV/10305—8) Polonium assimilation and retention in mule deer and pronghorn antelope.** Sejkora, K.J. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Fal 1982. Contract AC02-79EV10305. 41p. NTIS, PC A03/MF A01. Order Number DE84001802.

Thesis.

Excretion kinetics and tissue distribution of polonium-210 in mule deer and pronghorn were studied. Each animal in a captive herd of 7 mule deer and 2 pronghorn received an intraruminal injection of 4.4 μCi of polonium chloride. Feces and urine were collected periodically over a 43-day period and daily excretion rate for each pathway was regressed as a function of time. Assimilation fractions of 0.40 and 0.51 were calculated for mule deer (n=2) and 0.60 for a pronghorn. Body burden retention functions were calculated from integrated excretion rate functions. Polonium burdens in muscle, liver, and kidney were calculated as a fraction of body burden from serially-sacrificed animals. Background tissue burdens in mule deer were comparable to those of other ruminants reported in the literature. Hypothetical cases were assumed which combined feeding rate of mule deer, forage concentrations of polonium, retention function, tissue burden fraction, and human intake to estimate human radiation dose. 26 references.

1315 **(DPST—82-708) Standardized dose factors for dose calculations - 1982 SRP reactor safety analysis report tritium, iodine, and noble gases.** Pillinger, W.L.; Marter, W.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 16 Jul 1982. Contract AC09-76SR00001. 6p. NTIS, PC A02/MF A01. Order Number DE84002821.

Standardized dose constants are recommended for calculation of offsite doses in the 1982 SRP Reactor Safety Analysis Report (SAR). Dose constants are proposed for inhalation of tritium and radioiodines and for submersion in a semi-infinite cloud of radioiodines and noble gases. The proposed constants, based on ICRP2 methodology for internal dose and methodology recommended by the US Nuclear Regulatory Commission for external dose, are compatible with dose calculational methods used at the Savannah River Plant and Savannah River Laboratory for normal releases of radioactivity. 8 references.

1316 **(FS—81-21-AKI) Monitoring the incorporation of iodine.** (Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.)). Nov 1982. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83751309.

Possible incorporation of radio-iodine can be revealed by external examination of the thyroid gland or by investigating a urine sample with a detector. When an incorporation has been detected, measures can be taken, which on the one hand reduce the uptake of radioiodine into the thyroid gland and which on the other hand shorten the biological half-life.

1317 **(GSF-S—936) Method for determination of the retention of inhaled aerosols.** Kreyling, W.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Mar 1983. 206p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE83751315.

A method is described by which activity distributions were measured in the lungs of beagles after inhalation of radiolabelled aerosols. This was the first time that the retention function of the various regions of the lungs was measured for periods of several months to several years on the basis of the time variations of the activity distribution. Retention in the respiratory tract is a function of the aerosol and its materials characteristics; in consequence, the author had to develop a method of aerosol production and analysis to ensure production of aerosols with specially selected physical and chemical properties. Determination of retention curves of a certain aerosol as a function of its aerosol parameters is a new method of interpreting the purification processes of the repsiratory tract.

1318 **(JAERI-M—82-063) Immobilization of yeast cells with various porous carriers by radiation-induced polymerization.** Fujimura, T.; Kaetsu, I. (Japan Atomic Energy Research Inst., Tokyo). Jun 1982. 14p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703704.

Yeast cells were immobilized by radiation-induced polymerization in twice. Various kinds of porous polymer carriers were prepared by radiation-induced polymerization of glass-forming monomers at a low temperature. Precultured yeast cells were incubated aerobically at 30°C with these porous carriers for 24 h. Porous carriers with yeast cells were immersed in low concentration monomer solution. Yeast cells were immobilized by radiation-induced polymerization. The maximum ethanol productivity in immobilized yeast system was around 10 times as much as that in free yeast cell system. High activity of immobilized yeast cells was maintained more than 480 h. The growth of yeast cells in immobilized yeast cells during aerobical incubation was indicated. Immobilized yeast cells thus grown were incubated for fermentation reaction. In this immobilized system, 100% of glucose was converted to ethanol, that is 100% ethanol yield was obtained, within 180 min. In free cell system, only 15% ethanol yield was obtained within 180 min. These results indicate clearly the superiority of immobilized growing cell. Yeast cells were also immobilized with non-woven material as carrier by radiation-induced polymerization. The relationship between pore size of non-woven material and activity in immobilized yeast cells was made clear.

1319 **(LA—9779-PR) Occupational health, waste management, and environmental research program of the Health Division 1981. Progress report.** Voelz, G.L. (ed.). (Los Alamos National Lab., NM (USA)). Sep 1983. Contract W-7405-ENG-36. 83p. NTIS, PC A05/MF A01. Order Number DE84002347.

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The primary responsibility of the Health Division at the Los Alamos National Laboratory is to provide effective programs in health, safety, waste processing, and environmental protection for the Laboratory. During 1981, evaluations of respiratory protective equipment included 3 special DOE contractor supplied-air suits or hoods and 10 commercial supplied-air devices. Preliminary results of chemical permeation tests of different protective garment materials are reported. Industrial hygiene field studies of oil shale work were conducted at the Geokinetics true in situ facility and the Rio Blanco modified in situ facility. An occupational medical survey of workers at the Geokinetics, Inc., facility was completed. Research on the generation and characterization of aerosols was continued for inhalation studies of man-made mineral fibers and oil shale aerosols. The distribution of ^{241}Am in a whole body was determined by tissue analyses. Preliminary results of mortality in workers formerly employed at the Rocky Flats plant were reported. A simplified method for the analysis of plutonium in urine has been developed. Instrumentation development resulted in a portable computer system for field data analysis and a small, computerized, wrist-watch-style radiation dosimeter. Environmental surveillance at Los Alamos during 1981 showed the highest estimated radiation dose due to Laboratory operations is about 4% of the dose due to the natural radioactivity here. A study was completed on alternative strategies for long-term management of Los Alamos transuranic wastes. A successful 10-day test burn of pentachlorophenol-contaminated wastes was conducted in the Controlled Air Incinerator. Decontamination factors for five fission products in the off-gas handling system of the incinerator were measured.

1320 **(LA—9858-MS) In-vivo assessment of whole-body radioisotope burdens at the Los Alamos National Laboratory.** Vasilik, D.G.; Aikin, I.C. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01. Order Number DE84002278.

The Los Alamos National Laboratory program for in-vivo measurements includes the capability for the whole-body assessment of body burdens for x-ray or gamma-ray emitting radioisotopes. This capability is an important part of the health and safety program at Los Alamos where a wide variety of radioisotopes are utilized. This report addresses the whole body portion of our in-vivo measurement capabilities. Whole-body measurements at Los Alamos make use of a hyperpure germanium (HpGe) detector and a lithium-drifted germanium [Ge(Li)] detector for identification and quantification of radioisotopes. Analysis results are interpreted in terms of two basic statistical measures of detection limits. One measure is called the minimum significant measured activity (MSMA), which is interpreted as meaning that there is some activity in the body. The second measure is called the minimum detectable true activity (MDTA), which is defined as the smallest amount of activity required to be in the body in order that a measurement of an individual can be expected to imply correctly the presence of activity with a predetermined degree of confidence. 7 references, 8 figures.

1321 **(LBL—16549) Lethal, potentially lethal lesion model.** Curtis, S.B. (Lawrence Berkeley Lab., CA (USA)). Jul 1983. Contract AC03-76SF00098. 25p. (CONF-830782—2). NTIS, PC A02/MF A01. Order Number DE84001325.

From 11. L. H. Gray conference on cellular repair of radiation damage - mechanisms and modifying agents; Glasgow, UK (18 Jul 1983).

A theoretical framework to describe the formation of lethal mutations by radiation is presented. Lesions that are repaired (and misrepaired) in each type of experiment described (delayed plating and split dose) are assumed to be the same. In this model the same (potentially lethal) lesions cause both sublethal and potentially lethal damage. Potentially lethal damage is defined as damage which may be modified by alterations in postirradiation conditions.

Sublethal damage is cellular damage whose accumulation may lead to lethality. A crucial consideration in the expression of the damage is the kind of medium in which the cells are placed during the repair period. Fresh or growth medium (F-medium) is assumed to cause fixation of damage after about 3 hours, while no fixation (only misrepair) occurs in conditioned medium (C-medium).

1322 **(N—8325350) Study of behavioral modifications resulting from exposure to high let radiation. Final Report.** Hightower, D.; Beaver, B.; Hall, C.L. (Texas A and M Univ., College Station (USA)). 1982. 65p. (NASA-CR—171651). NTIS, PC A04/MF A01.

Animal irradiations, behavioral studies, neurological studies, and nuclear medicine studies are discussed.

1323 **(OEFZS-A—0414) Molecular biological investigation on lymphocytes of patients with Morbus Crohn.** Broell, H.; Keck, M.; Altmann, H.; Emerit, I.; Emerit, J. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Mar 1983. 12p. (In German). (BL—423/83). Available by the Austrian Academy of Sciences, Dr. Ignaz Seipelplatz 2, 1010 Vienna.

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Semiconservative DNA-synthesis in lymphocytes of patients with Morbus Crohn was significantly enhanced compared to controls. No trend and no significant difference to the controls were detected on DNA-repair, poly(ADP-ribose)synthesis after UV-irradiation and poly(ADP-ribose)synthesis without damage. In the case of the acute disease stage NAD incorporation in poly(ADP-ribose) was increased 120 min and 20 hours after UV-damage. In all cases of M. Crohn there were changes in chromatin structure.

1324 **(ORNL—6003) Bioenvironmental aspects of europium and rhodium: a selected bibliography.** Fore, C.S.; Carrier, R.F.; Talmage, S.S.; Fielden, J.M.; Daniel, E.W. (Oak Ridge National Lab., TN (USA)). Sep 1983. Contract W-7405-ENG-26. 290p. (NVO/AEIC—262). NTIS, PC A13/MF A01. Order Number DE84002741.

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This bibliography of 428 abstracted references represents a summary of the domestic and foreign literature relevant to the biological and environmental aspects of europium and rhodium. The collected data are organized by current NAEG interests - research highlighting inventory and distribution of the radionulcides, ecological studies covering terrestrial and aquatic systems, and biological studies in both man and animals. Studies that focus directly on research conducted at specific sites (e.g., the Nevada Test Site) are emphasized throughout the bibliography. (ACR)

1325 **(ORNL/CSD—123) Maximum likelihood estimation for cytogenetic dose-response curves.** Frome, E.L; DuFrain, R.J. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Oct 1983. Contract W-7405-ENG-26. 35p. NTIS, PC A03/MF A01. Order Number DE84001582.

In vitro dose-response curves are used to describe the relation between the yield of dicentric chromosome aberrations and radiation dose for human lymphocytes. The dicentric yields follow the Poisson distribution, and the expected yield depends on both the magnitude and the temporal distribution of the dose for low LET radiation. A general dose-response model that describes this relation has been obtained by Kellerer and Rossi using the theory of dual radiation action. The yield of elementary lesions is $\kappa[\gamma d + g(t, tau)d^2]$, where t is the time and d is dose. The coefficient of the d^2 term is determined by the recovery function and the temporal mode of irradiation. Two special cases of practical interest are split-dose and continuous exposure experiments, and the resulting models are intrinsically nonlinear in the parameters. A general purpose maximum likelihood estimation procedure is described and illustrated with numerical examples from both experimental designs. Poisson regression analysis is used for estimation, hypothesis testing, and regression diagnostics. Results are discussed in the context of exposure assessment procedures for both acute and chronic human radiation exposure.

1326 **(UCRL—89917) Cytometric analysis of shape and DNA content in mammalian sperm.** Gledhill, B.L. (Lawrence Livermore National Lab., CA (USA)). 10 Oct 1983. Contract W-7405-ENG-48. 33p. (CONF-8310184—1). NTIS, PC A03/MF A01. Order Number DE84001786.

From National institute of child health and human development testis workshop; Bethesda, MD, USA (14 Oct 1983).

Male germ cells respond dramatically to a variety of insults and are important reproductive dosimeters. Semen analyses are very useful in studies on the effects of drugs, chemicals, and environmental hazards on testicular function, male fertility and heritable germinal mutations. Sperm were analyzed by flow cytometry and slit-scan flow analysis for injury following the exposure of testes to mutagens. The utility of flow cytometry in genotoxin screening and monitoring of occupational exposure was evaluated. The technique proved valuable in separation of X- and Y-chromosome bearing sperm and the potential applicability of this technique in artificial insemination and a solution, of accurately assessing the DNA content of sperm were evaluated-with reference to determination of X- and Y-chromosome bearing sperm.

1327 **Estimation of a single property of low LET radiations which correlates with biological effectiveness.** Goodhead, D.T. (Medical Research Council, Harwell (UK). Radiobiological Research Unit); Brenner, D.J. (Los Alamos National Lab., NM (USA)). *Physics in Medicine and Biology;* **28**: No. 5, 485-492(May 1983).

The biological effectiveness of ionising radiation is believed to be related to the initial structure of the radiation tracks. In this paper, an attempt is made to identify a single physical property of the radiation field that correlates with relative biological effectiveness. This property has been sought in terms of a minimum amount of energy deposition in a certain volume. In order to quantify this approach detailed Monte Carlo track structure simulations have been made of x-rays of widely differing energies and the results have been compared with previously reported experiments of cell killing by these radiations. In terms of the above threshold energy concept, we have thus identified a putative critical property of radiations of low ionisation density such as x-rays, namely the rare occurrence of energy deposition of >approximately 100 eV in a volume of about 3 nm diameter.

1328 **Modifiers of free radicals inhibit in vitro the oncogenic actions of x-rays, bleomycin, and the tumor promoter 12-O-tetradecanoylphorbol 13-acetate.** Borek, C.; Troll, W. (Institute of Cancer Research, New York, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **80**: No. 5, 1304-1307(Mar 1983). Contract AC02-78EV04733.

Using short-term cultures of hamster embryo cells, we have examined the effects of the free-radical scavenger superoxide dismutase (superoxide:superoxide oxidoreductase, EC 1.15.1.1) and the enzyme catalase (hydrogen-peroxide:hydrogen-peroxide oxidoreductase, EC 1.11.1.6) on x-ray-and bleomycin-induced transformation and on the enhancement of radiogenic transformation by the tumor promoter 12-O-tetradecanoylphorbol 13-acetate (TPA). We find that superoxide dismutase inhibits (i) transformation induced by x-ray and bleomycin and (ii) promotional action of TPA in vitro. The results suggest that the oncogenic action of x-rays and bleomycin and the enhancement of oncogenic transformation by TPA are mediated in part by free radicals. The findings also suggest that superoxide dismutase can serve as an inhibitor of oncogenesis and that its actions, as seen in this in vitro system, are most predominantly on inhibiting late events in the progression of cellular transformation--those associated with promotion.

1329 **An evaluation of several methods for assessing the effects of occupational exposure to radiation.** Gilbert, E.S. (Pacific Northwest Laboratory, Richland, Washington). *Biometrics;* **39**: No. 1, 161-171(Mar 1983).

Several methods for the analysis of occupational radiation exposure data, including procedures based on Cox's proportional hazards model, are presented and evaluated. Issues of interest include the contribution of an external control, the effective handling of highly skewed exposure data, and the potential for detecting ef-

fects in populations occupationally exposed to radiation. Expressions for evaluating the power of various procedures are derived and applied to data from the Hanford population in order to determine power curves for detecting leukemia effects, with both additive and multiplicative linear models being used. It is found that the introduction of an external control can increase power, although not when an overall adjustment factor must be estimated from the data or when death rates for the study population are substantially lower than those for the control population. It is also found that very little power is lost if exposures are grouped. Finally, the power calculations indicate, as expected, that in analyses of occupationally exposed populations, such as the Hanford workers, there is very little chance of detecting radiation effects at the levels of our current estimates. However, power is reasonably good for detecting effects that are 10 to 15 times larger.

1330 **Role of 4-thiouridine in lethal effects and in DNA backbone breakage caused by 334 nm ultraviolet light in Escherichia coli.** Peak, M.J.; Peak, J.G.; Nerad, L. (Argonne National Lab., IL (USA)). *Photochemistry and Photobiology;* 37: No. 2, 169-172(Feb 1983).

Strains of Escherichia coli that lack 4-thiouridine (^{4}Srd) are killed by monochromatic 334 nm UV light (UV) less efficiently than their wild-type parents, which contain ^{4}Srd. Oxygen enhancement ratios (OER) at 10% survival are 3.3 for a strain that possesses ^{4}Srd, and 2.6 for one that lacks ^{4}Srd. Single-strand breaks in DNA caused by 334 nm UV accumulate more than twice as fast in the wild-type strains than in the strains lacking ^{4}Srd. The results suggest that ^{4}Srd is an important chromophore in some near-UV lethal effects. The results also suggest that the excitation energy from 334 nm UV light may be passed from RNA to DNA, resulting in single-strand breaks.

1331 **Single-strand DNA breaks induced by 365 NM radiation in Escherichia coli strains differing in sensitivity to near and far UV.** Tuveson, R.W.; Peak, J.G.; Peak, M.J. (Argonne National Lab., IL (USA)). *Photochemistry and Photobiology;* 37: No. 1, 109-112(Jan 1983).

The gene mutation nur has been shown specifically to sensitize Escherichia coli stationary phase cells to inactivation by broad spectrum near-UV (NUV) radiation. E. coli strains RT1, RT2, RT3, and RT4, carrying the 4 possible combinations of recA1, recA$^+$, nur, and nur$^+$, were exposed to monochromatic NUV (365 nm). The strains carrying the nur allele (RT1 and RT2) were more sensitive to inactivation by this wavelength and exhibited considerably more single strand break's (SSB's) than the strains carrying the nur$^+$ allele (RT3 and RT4). As predicted, following X-irradiation the strains carrying the recA1 allele (RT1 and RT3) were more sensitive than the recA$^+$ strains (RT2 and RT4). It was concluded that the enhanced SSB's observed in strains RT1 and RT2 following monochromatic NUV irradiation correlated with the nur mutation and are unrelated to the recA1 mutation.

1332 **Induction of pyrimidine dimers and unscheduled DNA synthesis in cultured mouse epithelial cells exposed to 254-nm- and u.v.-B radiation.** Yotti, L.P.; Ley, R.D. (Biology Division, Oak Ridge National Laboratory, TN). *Carcinogenesis (New York);* 4: No. 7, 923-925(1983).

The induction and fate of pyrimidine dimers and unscheduled DNA synthesis were measured in u.v.-irradiated primary, newborn SENCAR mouse epithelial cells. Unscheduled DNA synthesis was induced in a dose responsive manner by two u.v. sources, a germicidal lamp (254 nm) and an FS40 sunlamp (280–400 nm). Using the endonuclease-sensitive site assay to detect pyrimidine dimer production and excision, we examined the response of the newborn mouse cells to both u.v. sources. We were unable to detect the removal of pyrimidine dimers with either of the two sources of u.v. The speculation is made that primary, newborn mouse epidermal cells excise u.v.-induced pyrimidine dimers to an extent below the level of detection of the endonuclease-sensitive site assay but to an extent sufficient to induce unscheduled DNA synthesis.

1333 **Observations on the bioaccumulation potential of thorium and uranium in rainbow trout (Salmo gairdneri).** Poston, T.M. (Pacific Northwest Lab., Richland, WA). *Bulletin of Environmental Contamination and Toxicology;* 28: No. 6, 682-690(Jun 1982). Contract AC06-76RL01830.

Preliminary studies are reported to determine if uptake of uranium and thorium occurs at significant rates in rainbow trout. Also assessed is how soluble and particulate partitioning affects the uptake behavior of these actinides. (JMT)

1334 **The ultrastructure of radiation-induced endosteal myelofibrosis in the dog.** Seed, T.M.; Chubb, G.T.; Tolle, D.V.; Fritz, T.F.; Poole, C.M.; Doyle, D.E.; Lombard, L.S.; Kaspar, L.V. (Argonne National Lab., IL). *Scanning Electron Microscopy;* 1: 377-391(1982). Contract W-31-109-ENG-38.

A rapidly developing, progressive form of endosteal myelofibrosis (MF) (with myeloid meta-plasia) has been shown to occur at low frequency (~ 4%) in dogs exposed continuously to low daily doses (10 R/day) of whole-body gamma irradiation. We report in this study the morphological details of the endosteal surface during both preclinical and clinical phases of developing MF by combination light microscopy and scanning/transmission electron microscopy. Pronounced alterations of the endosteum were observed and included:(1) during the early preclinical phases, a progressive time-dependent transition of the endosteal surface from predominantly resting to actively formative and resorptive states; and (2) during the late preclinical phase, aberrant autonomous osteogenic process(es) characterized by a marked reduction in the resorptive, osteoclast-associated endosteal areas occuring concomitantly with further increases in formative areas of the endosteum. Localized patches of overlapping, morphologically transformed endosteal cells (i.e., round-osteoblastic to branched-reticular shaped) were observed within the morphologically reactive, formative endosteum. Osteogenic-endosteal change coincided with major restructuring of the hematopoietic parenchyma and supporting stromal network. We discuss the possibility that the early occurring endosteal changes are causally linked to normal reparative functions that operate during regenerative hematopoiesis following local and systemic injury. Based on morphological data collected during the late preclinical phase, we speculate that the mechanism of myelofibrosis induction involves the failure to terminate early osteogenic-dependent repair sequences.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 1260

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 93, 126, 185, 185, 1176, 1224, 1290, 1300, 1319, 1328

1335 **(AD-A—130189/4) Sensitization potential of triethylenediamine impregnated charcoal. Interim report Jun 82-Jun 83.** Metker, L.W.; Weyandt, T.B. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). 30 Jun 1983. 10p. (USAEHA—75-51-1124-83). NTIS, PC A02/MF A01.

Triethylenediamine was evaluated for its respiratory sensitization potential by means of inhalation exposures in male guinea pigs. A positive control, Toluenediisocyanate was used to demonstrate the validity of the test system. Additional testing is required but testing to date indicates that this material is not a respiratory sensitizer.

1336 **(CONF-811057—4) Overview of tumor promotion in animals.** Slaga, T.J. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE84001938.

From EPA/HERL international symposium on health effects of tumor promotion; Cincinnati, OH, USA (13 Oct 1981).

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Our present understanding of two-stage carcinogenesis encompasses almost four decades of research. Evidence for chemical promotion or cocarcinogenesis was responsible in defining many important aspects of the initiation and promotion of two-stage carcinogenesis. The initiation stage in mouse skin requires only a single application of either a direct-acting carcinogen or a procarcinogen and is essentially an irreversible step which as data suggests probably involves a somatic cell mutation. The promotion stage in mouse skin can be accomplished by a wide variety of weak or noncarcinogenic agents amd is initially reversible later becoming irreversible. Current information suggests that skin tumor promoters are not mutagenic but bring about a number of important epigenetic changes, such as epidermal hyperplasia, and an increase in polyamines, prostaglandins and dark basal keratinocytes as well as other embryonic conditions. Recently, tumor promotion in mouse skin was shown to consist of at least two stages, in which each stage can be accomplished by either a known promoter or a weak or nonpromoting agent. The second stage of promotion is initially reversible but later becomes irreversible. Polyamines and epidermal cell proliferation are important events in the second stage of promotion. A number of weak or nonpromoting agents, such as mezerein, are effective second-stage promoters which can be counteracted by retinoic acid, antinflammatory steroids and polyamine synthesis inhibitors.

1337 **(CONF-821048—5) Biotransformation of aromatics: metabolic conversion of nitrogen-containing derivatives of benzo(a)pyrene.** Tong, S.; Selkirk, J.K. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences). 1982. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01. Order Number DE84002063.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

The metabolism of two nitrogen-containing polycyclic aromatic hydrocarbons, 6-nitroB(a)P and 10-azaB(a)P, was studied in an intact cell system consisting of hamster embryonic fibroblasts and a cell-free system employing rat-liver microsomes. For both compounds, HPLC separation of microsomal metabolites indicated the predominant presence of phenolic products with only small amounts of dihydrodiols formed. In contrast, incubation of the chemicals with hamster cells yielded dihydrodiols as major organic solvent-soluble products. On closer examination, it was found that while phenols were formed they were conjugated with glucuronic acid to become water-soluble products, and therefore, did not accumulate in their free phenolic form. Studies in the nuclear macromolecular binding of the two compounds showed that 6-nitroB(a)P was bound to DNA, RNA, and proteins with much the same affinity as that exhibited by B(a)P whereas the specific binding activities for 10-azaB(a)P were several fold lower in all cases. This may be explained by the substitution of a nitrogen atom in an important metabolic region in the B(a)P molecule thus altering its potential macromolecular binding properties. 26 references, 9 figures, 2 tables.

1338 **(CONF-821048—7) Extrapolation of ecotoxicity data: choosing tests to suit the assessment.** Suter, G.W. II; Vaughan, D.S. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01. Order Number DE84002068.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

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The test species and test types used in aquatic toxicology should be selected to suit the needs of assessment. Sensitive tests would be desirable in the screening phase of hazard assessment, but none of the standard screening tests are consistently sensitive. A better criterion for test selection is the ability of a particular test to predict the responses of other species and other test types. This predictive ability is shown by correlation analysis. The variance in a correlation can be used to generate the risk in a risk analysis or the cutoff concentrations in a hazard assessment. Examination of a variety of correlations suggests that more attention needs to be paid to invertebrate toxicology relative to fish toxicology. 20 references, 3 figures.

1339 **(CONF-821048—9) Evaluation of biohazards using skin in organ culture.** Kao, J.Y.; Shugart, L.R.; Holland, J.M. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01. Order Number DE84001953.

From 5. Life Sciences symposium on synthetic fossil fuel technologies; Gatlinburg, TN, USA (24 Oct 1982).

An in vitro short term organ culture system has been developed for maintaining metabolically viable and structurally intact mouse skin. Using this system, the responses of mouse skin to in vitro chemical insults were assessed by selected biochemical parameters. Studies with the irritant tributyltin chloride showed that the degree of cellular injury was reflected by inhibition of in vitro incorporation of ^{3}H-thymidine and ^{14}C-leucine into epidermal DNA and protein, respectively. In addition, there was leakage of intracellular enzymes into the culture medium in a dose and time related manner. When skin samples were exposed to complex irritant mixtures, e.g., H-coal distillates, leakage of intracellular enzymes was also observed. This in vitro system is potentially adaptable for use with skin samples from other species, including man. It offers a means whereby species differences may be examined under defined conditions and also allows for a quantitative basis for assessing cutaneous toxicity of chemicals and complex mixtures in vitro.

1340 **(CONF-8210100—5) Quantitating benzo[a]pyrene binding to DNA by fluorescent analysis.** Shugart, L.; Rahn, R.O.; Holland, J.M. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE84001946.

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

We have demonstrated that fluorimetry, when coupled with HPLC, is an alternative method to radiometric detection of BaP binding to DNA. Other workers have used HPLC with absorbance detection to monitor the appearance of pyrenyl moieties following acid hydrolysis of diolepoxides of benzopyrene (BaPDE) from DNA, while HPLC with fluorescence detection has also been used to study the BaPDE-deoxynucleoside adducts released following enzyme hydrolysis of BaPDE-DNA. The method described here combines the simplicity of acid hydrolysis and the sensitivity of fluorescence detection to arrive at a reproducible method of analysis which is simple, sensitive and straighforward. When considered with other data of ours, we believe that mouse skin in organ culture is a suitable diagnostic technique for studying the carcinogenic potential of chemicals and complements our research in the whole animal.

1341 **(DOE/ER/70185—T2) Respiration of roots response to low O_2 stress. Final report.** Beevers, H. (California Univ., Santa Cruz (USA). Dept. of Biology). 1983. Contract AT03-76ER70185. 4p. NTIS, PC A02/MF A01. Order Number DE83017495.

Progress is reported in the following research aras: effects of O_2 concentration on rice seedlings; alcohol dehydrogenase and an inactivator from rice seedlings; and properties and intracellular location of alcohol dehydrogenase from rice seedlings. (ACR)

1342 **(DOE/EV/03490—2335) Exposure chamber for studies of pollutant gases and aerosols in human subjects: design considerations.** Utell, M.J.; Morrow, P.E.; Hyde, R.W.; Schreck, R.M. (Rochester Univ., NY (USA); General Motors Research Labs., Warren, MI (USA)). 1983. Contract AC02-76EV03490. 10p. (CONF-8309167—2). NTIS, PC A02/MF A01. Order Number DE84001135.

From Annual meeting of Association for Aerosol Research; Munich, F.R. Germany (13 Sep 1983).

An exposure chamber was designed and built at the University of Rochester Medical Center for studies of human volunteers exposed to gaseous and/or aerosol pollutants for periods of hours to days. The 45 m^3 chamber normally operates at an air change rate of 10 m^3/min with ranges in temperature from 10° to 31.5°C and relative humidity from about 25 to 85%. Aerosols are produced by an eight-jet D-31 nebulizer, electrically neutralized and introduced into the chamber inlet air via a venturi mixer and five ceiling diffuser inlets. The aerosols can range in size from submicron to several microns and final chamber concentrations of 10 to several thousand

micrograms per cubic meter can be produced having a spatial variation within the chamber of +-5% of the mean. The particulate environment within the chamber can be continuously monitored by a particle size analyzer and nephelometer and gas concentrations by chemical analyzers. Pollutant gases are obtained as standardized compressed gases and introduced into the chamber via the same venturi mixer. A safety alarm will sound if pollutant concentrations vary significantly about predetermined safe levels or is variations occur in the ventilation system. The chamber is equipped with a bicycle ergometer and body plethysmograph for pulmonary function testing during pollutant exposure. To date, initial studies have been performed on healthy and asthmatic volunteers exposed to sulfate and sulfuric acid aerosols for four hours. 7 references, 1 figure, 1 table.

1343 **(DOE/EV/03490—2338) Clearance of $^{59}Fe_3O_4$ particles from the lung of rats during exposure to coal mine dust and diesel exhaust.** Oberdorster, G.; Green, F.H.Y.; Freedman, A.P. (Rochester Univ., NY (USA); National Inst. for Occupational Safety and Health, Cincinnati, OH (USA); Hahnemann Medical Coll. and Hospital, Philadelphia, PA (USA). Medicine-Pulmonary Dept.). 1983. Contract AC02-76EV03490. 8p. (CONF-8309167—1). NTIS, PC A02/MF A01. Order Number DE84000887.

From Annual meeting of Association for Aerosol Research; Munich, F.R. Germany (13 Sep 1983).

Experiments in rats were performed to investigate the influence of diesel/coal dust exposure on lung clearance of inert tracer particles. Four groups of 80 rats each were exposed as follows: (1) Coal mine dust, 2 mg/m^3; (2) Diesel exhaust, 2 mg/m^3); (3) Coal mine dust (1 mg/m^3) plus diesel exhaust (1 mg/m^3); (4) Filtered air (control). The exposure was for 7 hours per day, 5 days per week for a period of 6 months. Two months after commencement of the study, all animals were exposed in nose only exposure units to $^{59}Fe_3O_4$ dust for 2 hours. Lungs of serially killed animals were excised and their ^{59}Fe activity measured. Biological half lives of long term clearance of Fe_3O_4 from the lung were 47 days (controls), 42 days (coal), 43 days (coal/diesel) and 37 days (diesel). $^{59}Fe_3O_4$ retention on day 120 was significantly lower in all exposure groups as compared to controls, with the diesel group showing the lowest retention (< 50% of controls). Short term clearance determined from Fe_3O_4 retention of day 1 was not significantly different between the groups. 11 references.

1344 **(GSF-OE—536) Possibilities for prompt test procedures for determining long-term accumulation effects of environmental chemicals in the food of warm-blooded animals.** Scheunert, I. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Attaching (Germany, F.R.). Inst. fuer Oekologische Chemie). 1981. 9p. (In German). Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.

Also published in Oekol. Voegel (Ecol. Birds) (1981)(no.3) p. 73-81, special issue.

In recent years the wish for a test procedure has been increasingly expressed whereby the behaviour of chemicals in the environment and their possible exotoxicity can be estimated before they are set free in the environment. Firstly the author discusses the possibility to forecast environmental behaviour on the basis of chemical structure. Water solubilities of a number of environmental chemicals are then compared to the results of short-term in vivo tests (accumulation in fish and rat feed). Water solubility alone is shown to be insufficient to predict accumulation levels. A further comparison between biological accumulation and relative fat solubility (octanol/water) shows that a predication is possible for the sequence of uptake in fish but not, however, for warm-blooded animals. A comparison between short-term and long-term tests follows and here, taking into account the necessary extrapolation, good agreement is found. A higher test procedure represents studies undertaken for the whole ecosystem and food chain and here possibilities and procedures are discussed briefly.

1345 **(IS—4818) Health and environmental research. Quarterly report, April 1-June 30, 1982.** (Ames Lab., IA (USA)). Nov 1982. Contract W-7405-ENG-82. 18p. NTIS, PC A02/MF A01. Order Number DE83016406.

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Progress is reported in procurement of necessary equipment and supplies for determination of the effects of particulates on organ cultures of the respiratory system. A literature reviewed identified trachea organ cultures as the organ of greatest exposure and susceptibility to induced injury and disease. Cultures of rat trachea and lung explants have been maintained for a 2 week period. (PSB)

1346 **(LA-UR—83-2677) Molecular and somatic-cell genetic analysis of metal-resistance mechanisms in mammalian cells.** Enger, M.D.; Hildebrand, C.E.; Walters, R.A.; Seagrave, J.C.; Barham, S.S.; Hoagland, H.C. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 20p. (CONF-8309164—1). NTIS, PC A02/MF A01. Order Number DE84001322.

From Molecular and cellular approaches to understanding mechanisms of toxicity conference; Boston, MA, USA (1 Sep 1983).

Combined molecular genetic analyses and somatic cell systems were utilized to delineate factors involved in metal metabolism. Somatic cells derived by selection procedures using toxic heavy metals were used to define primary factors involved in acquisition of metal resistance. Such cell variants permitted isolation of the specific genes involved in conferring heavy metal binding proteins, the metallothioneins. (MT). These isolated genes provided the molecular probes to dissect the multiple levels of control and organization of this one set of genes responsible for metal resistance. Studies on the roles of MT in metal resistance used these variants and cell lines derived from human tumors to illustrate that MTs play an important but not exclusive role in cadmium detoxification. Studies on Cd^{++} responses in human tumor derived cell lines showed several orders of magnitude differences in Cd^{++} sensitivity in lines having similar MT responses. Analysis of cultured normal blood cell responses showed that the most Cd^{++} resistant population, the granulocytes, did not produce significant quantities of MT. The results presented here further show a lack of correlation between MT and cytotoxic responses to Cd^{++} in freshly cultured human leukemic peripheral blood cells. In these, enhanced Cd^{++} uptake may be a factor determining enhanced sensitivity. Theses results together indicate that an adequate understanding of cellular responses to toxic metals will not be provided by elucidation of the role(s) of one or a few known metal binding proteins such as MT. Other factors and systems that modulate cellular uptake and sensitivity must first be defined.

1347 **(LA-UR—83-3093) Alterations in the metabolism of benzo[a]pyrene in syrian hamster embryo (SHE) cells pretreated with phenolic antioxidants.** Strniste, G.F.; Okinaka, R.T.; Chen, D.J. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 16p. (CONF-8310179—2). NTIS, PC A02/MF A01. Order Number DE84001723.

From 8. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1983).

Inhibition of chemical- or raddiation-induced neoplasia has been observed in animals whose diets were supplemented with antioxidants commonly used as food additives. Inhibition of the carcinogenicity of benzo[a]pyrene (BaP) or of 7,12-dimenthylbenz[a]anthracene (DMBA) - in rats has been achieved by the addition of the phenolic antioxidants butylated hydroxyanisole (BHA) or butylated hydroxytoluene (BHT) to the diet. Our data suggest that in SHE cells antioxidants inhibit the overall metabolism of BaP to its various oxidized moieties including 7,8-diol- and 7,8,9,10-tetrol-BaP. A plausible explanation for our results with SHE cells is that the antioxidants interact directly with AHH, thus inhibiting AHH metabolic capacity. From analysis of nuclear material from SHE cells (+- antioxidants) incubated for 36 hours with BaP at 1 μg/ml, it is calculated that 4.6, 2.4 and 2.9 pmol BaP are bound to the DNA isolated from 10^7 nuclei of control, BHA-(20 μg/ml) and p-MP-(10 μg/ml) treated cultures, respectively.

1348 **(NP—4900286) Soybeans: diagnosis and correction of manganese and molybdenum problems.** Anderson, O.E.; Mortvedt, J.J. (eds.). (Georgia Univ., Athens (USA). Agricultural Experiment Station). Dec 1982. 103p. Georgia Agricultural Experiment Station, 125 Barrow Hall-University of Georgia, Athens, GA 30602.

Southern Cooperative Series Bulletin 281.

Results of this study suggest that Mn deficiency may be a problem for soybeans on poorly-drained coastal plains soils with a pH > 6.0. Deficiencies on the above soils may be corrected by broadcast Mn rates of 10 to 20 kg/ha as $MnSO_4$. Potential Mn deficiencies may be predicted locally within the region using any of the soil extractants evaluated, but soil pH also should be included in the soil test interpretation. In contrast, potential Mn toxicities on some scils, especially high-Mn, fine-textured soils, can be predicted by measuring soil pH alone. Soybeans responded differently to applied Mo at the various soils pH levels across the region even though all of these soils had relatively low levels of available Mo. In general, Mo applications up to 800 g/ha or lime applications increased yields on soils with pH levels < 5.7, suggesting that this was the critical soil pH for obtaining response to Mo or lime. Because it is difficult to accurately measure the low concentrations of Mo in soil extracts and in plant tissue, the marginal Mo status of soils and the basic mechanisms involved in the soil-plant relationships of Mo are not well understood. 80 references.

1349 **(PB—83-238998) Vivo fate of nitrogenous air pollutant derivatives - Report 3 (Project Title). Final report Aug 80-Feb 82.** Parks, N.J.; Krohn, K.A. (California Univ., Davis (USA). Crocker Nuclear Lab.). Feb 1982. 83p. NTIS, PC A05/MF A01.

The project was designed to study the transport, organ distribution and elimination of nitrate and nitrite after inhalation and determine whether the pharmacological data base relating nitrate and nitrite metabolism after ingestion applies to inhalation.

1350 **(PB—83-239640) Toxicological investigation of fine particle emissions from oil-fired power plants. Final report Jul 79-Jan 81.** Kimble, B.J.; Raabe, O.G.; Wei, C.; Silberman, D. (California Univ., Davis (USA). Lab. for Energy-Related Health Research). Oct 1982. 95p. NTIS, PC A05/MF A01.

Detailed studies have been conducted of the stack-collected fine particles collected at a representative oil-burning power plant in Southern California. Samples were collected over a three-week period with a two-stage particle sampler designed to aerodynamically classify the particles and collect them into coarse and fine fractions respectively. Detailed studies were conducted of the physical and chemical characteristics of the collected particles showing the coarse particles to consist of some pitted cinder-like particles, some iron rust-like particles, and metallic sulfates. The fine particles consisted primarily of metallic sulfates and were 85% soluble in water (suggesting considerable solubility in body fluids), with an important fraction being associated with the biologically active nickel and vanadium sulfates. Biological studies of the mutagenesis of these oil fly ash particles showed that there was some slight mutagenic activity indicated and also there was considerable cellular toxicity demonstrated by in vitro exposure of rabbit pulmonary alveolar macrophages to these fly ash particles at different concentrations, possibly associated with elevated vanadium levels.

1351 **(PB—83-239749) Cell-mediated mutagenesis, an approach to studying organ specificity of chemical carcinogens.** Langenbach, R.; Nesnow, S. (Health Effects Research Lab., Research Triangle Park, NC (USA)). Jul 1983. 18p. (EPA—600/D-83-029). NTIS, PC A02/MF A01.

A number of approaches have been employed to elucidate the causes of organ and species specificity. In the earlier studies, homogenates of various tissues were used to metabolically activate the chemical; however, metabolite profiles, DNA-adduct profiles, and induced mutagenic responses of cell homogenates differ from those of intact cells. More recent studies have looked at the nature of carcinogen metabolites and DNA-adducts formed in cells or tissues or at the nature and persistence of DNA-adducts in in vivo tissues. Differences in the results from these various approaches are apparent. In addition, the nature and amount of DNA-adducts are only correlated with the biological response expected in the tissue. The ability to measure a biological response from system well as parameters such as chemical metabolism, DNA adducts, DNA repair, etc., would provide a useful system for elucidating some of the biological mechanisms leading to the phenomena of specificity.

1352 **(PB—83-241372) National Crop Loss Assessment network (NCLAN) 1981 annual report.** Heck, W.W.; Taylor, O.C.; Adams, R.M.; Bingham, G.; Miller, J.E. (North Carolina State Univ., Raleigh (USA). Dept. of Botany). Jun 1983. 206p. NTIS, PC A10/MF A01.

The National Crop Loss Assessment Network (NCLAN) consists of a group of cooperating organizations engaged in field work, crop modeling, and economic studies to assess the immediate and long-term economic consequences of the effects of air pollution on crop production. The program's primary objectives are (1) to define the relationship between yields of major agricultural crops and does of ozone, sulfur dioxide, nitrogen dioxide, and their mixtures using state-of-the-art technology in the field with realistic pollutant exposure regimes and (2) to utilize these relationships in assessing the economic consequences of exposure of agricultural crops to these pollutants.

1353 **Toxicant-induced fecundity compensation: a model of population responses.** Jensen, A.L.; Marshall, J.S. (Univ. of Michigan, Ann Arbor). *Environmental Management;* **7**: No. 2, 171-175(Mar 1983).

A mathematical model widely applied in population studies and in assessment of the impact of exploitation on fish populations was applied to assess cadmium toxicity in laboratory populations of Daphnia galeata mendotae. Over a range of toxicant concentrations, the birth rate of the population increased to balance the death rate and the population compensated for the increased mortality. The model describes the relation between toxicant concentration, toxicant-induced mortality, and equilibrium population size. Compensation for increased mortality is described in terms of the decrease in population size necessary to produce an increase in the birth rate that will balance the increased death rate. The relative capacity of different aquatic organisms to compensate for toxicant-induced mortality is examined and a relation between compensatory capacity and the innate capacity for increase is developed.

1354 **Induction and expression of mutations at multiple drug-resistance marker loci in Chinese hamster ovary cells.** Adair, G.M.; Carver, J.H. (Univ. of Texas System Cancer Center, Smithville). *Environmental Mutagenesis;* **5**: No. 2, 161-175(1983). Contract W-7405-ENG-48.

We observed quantitative and qualitative differences in the mutability and mutagen-specificity of various drug-resistance marker loci in Chinese hamster ovary (THO) cells, which suggest that mammalian gene loci may differ in their relative mutability by a given mutagenic agent. We have used the CHO-AT3-2 multiple-marker mutagenesis assay system to examine the dose-dependent induction and kinetics of expression of mutations at four well-characterized, drug-resistance marker loci, after treatment with chemical agents which produce various types of DNA damage. The CHO-AT3-2 subline allows simultaneous quantitation and direct comparison of induced mutation frequencies at the hgprt, oua (Na^+/K^+ ATPase), aprt, and tk loci. The agents tested in this study included ethyl methanesulfonate, methyl methanesulfonate, mitomycin C, ICR-191, benzo[a]pyrene, and dimethylnitrosamine. The expression kinetics and optimal expression times for each drug-resistance marker were determined in dose-response experiments in which cells from mutagen-treated populations were plated at 1-2-day intervals over a period of 10 days following mutagenesis. Comparison of induced mutation frequencies for each drug-resistance marker after mutagen treatments yielding equivalent cell survivals (equitoxic doses resulting in relative cell survivals of 0.37) revealed locus-specific differences in the relative mutagenicities of the agents tested. These results indicate that the apparent mutagenicity of a particular agent at a single genetic locus may not necessarily be an accurate indicator of that agent's mutagenic potential for the genome as a whole.

1355 **Feeding supplemental iodine to mink: reproductive and histopathologic effects.** Jones, R.E.; Aulerich, R.J.; Ringer, R.K. (Argonne National Laboratory, IL). *Journal of Toxicology and Environmental Health;* **10**: No. 3, 459-471(Sep 1982).

Adult mink were fed various concentrations of supplemental iodine, ranging from 10 to 320 ppm, for 1 or 7 mo before breeding.

Long-term, low-level (10-20 ppm) iodine supplementation was beneficial for both reproduction and lactation. Supplemental iodine in excess of 80 ppm, however, resulted in a reduction in the number of females that whelped, a decrease in litter size, and an increase in kit mortality. Thyroid glands of kits whelped and nursed by dams fed more than 20 ppm supplemental iodine, both short-term and long-term, showed hypertrophy marked by follicular cell hyperplasia and a decreased amount of colloid. Similar histopathologic lesions were observed in the thyroids of adults that received 80 ppm or more supplemental iodine; also observed were numerous lesions in the gallbladder.

1356 **Changes in phospholipid biosynthetic enzymes in type II cells and alveolar macrophages isolated from rat lungs after NO_2 exposure.** Wright, E.S.; Vang, M.J.; Finkelstein, J.N.; Mavis, R.D. (Univ. of Rochester School of Medicine and Dentistry, NY). *Toxicology and Applied Pharmacology;* 66: 305-311(1982). Contract AC02-76EV03490.

The activities of phospholipid biosynthesizing enzymes and subcellular marker enzymes were measured in type II cells and alveolar macrophages isolated from rat lungs 48 hr after exposure to air or 40 ppm NO_2. DNA and protein increased in cell fractions from NO_2-exposed lungs, but NO_2 exposure had no effect on the percentage of type II cells in isolated cell fractions. A general increase in cell content of biosynthetic enzyme activities (units/mg DNA) was observed in type II cells from NO_2-exposed rats, but no change was detected in the activity of the microsomal marker enzyme, NADPH cytochrome c reductase. Glycerolphosphate acyltransferase and choline phosphotransferase increased 171 and 168%, respectively, and phosphatidate phosphohydrolase increased 69%. Glycerolphosphate phosphatidyltranferase increased 143% and succinate cytochrome c reductase, the mitochondrial marker enzyme, increased 111%. Type II cells from control lungs contained a greater than threefold higher activity of the phosphatidylglycerol synthesizing enzyme, glycerolphosphate phosphatidyltransferase, compared to alveolar macrophages, and comparable activities of the enzymes of phosphatidylcholine synthesis and of the microsomal and mitochondrial reductases. Exposure to NO_2 resulted in a significant increase in NADPH cytochrome c reductase activity (46%) in macrophages, but no change in any biosynthetic enzymes. The increases in protein content and activity of phospholipid biosynthetic enzymes in type II cells are consistent with a general hypertrophy of type II cells which includes stimulation of surfactant phospholipid biosynthesis 2 days after exposure to NO_2 when type II cell proliferation is occuring.

1357 **(BNL-tr—1010) Biodegradation of polyethylene by micro-organisms.** Yogo, M.; Minoda, Y. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract AC02-76CH00016. Translation of Japanese Patent 1977-56175. 10p. NTIS, PC A02/MF A01. Order Number DE84002546.

The inventors studied various bacteria and fungi in relation to the biodegradation of polyethylene in soil, and confirmed that the bacteria from acinetobacter and the fungi belonging to cunninghamella grow in soil containing polyethylene, using it as the sole source of carbon, and decompose polyethylene sheets.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 1298

1358 **(DOE/RA/50293—1) Behavioral and prenatal effects of 60-Hz fields.** (Randomline, Inc., Huntingdon Valley, PA (USA)). Aug 1983. Contract AC02-80RA50293. 26p. NTIS, PC A03/MF A01. Order Number DE84001126.

Purpose was to determine possible neural, behavioral, and reproductive effects of low-intensity 60-Hz electric fields on mammals (rats) exposed in-utero. The tests used shortly after birth included negative geotaxis, the acoustic startle response, surface righting, in-air righting, cliff avoidance, emotionality, and swimming endurance. Variations between the exposed and control groups are discussed. 9 tables. (DLC)

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 160, 1298, 1719

1359 **(CONF-831047—89) Criticality emergency planning at Oak Ridge National Laboratory.** Green, J.H.; Cain, G.C. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE84001959.

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

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A plan to protect personnel and control the spread of contamination in the event of a radiation accident at Oak Ridge National Laboratory (ORNL) is outlined. Procedures and personnel are presented. (ACK)

1360 **(DOE/SSDC—17) Applications of MORT to review of safety analyses.** Briscoe, G.J.; Lofthouse, J.H.; Nertney, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1979. Contract AC07-76ID01570. 41p. NTIS, PC A03/MF A01. Order Number DE84000496.

This report is a guide to evaluating a safety analysis program and determining the content and structure of a safety analysis report. It is intended as an aid in evaluating the quality and consistency of various safety analysis processes. The report highlights those elements that will make a safety analysis program functional and effective and provides an appraiser with a means to evaluate a safety analysis program. Finally by proper scaling and choice of analytical methods, it provides the means to determine the content and structure of a safety analysis report.

1361 **(DOE/SSDC—76-45/4-Rev.2) MORT user's manual for use with the management oversight and risk tree analytical logic diagram.** Knox, N.W.; Eicher, R.W. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1983. Contract AC07-76ID01570. 71p. (SSDC—4-Rev.2). NTIS, PC A04/MF A01. Order Number DE84000490.

This report is the User's Manual for MORT, a logic diagram in the form of a work sheet that illustrates a long series of interrelated questions. MORT is a comprehensive analytical procedure that provides a disciplined method for determining the causes and contributing factors of major accidents. Alternatively, it serves as a tool to evaluate the quality of an existing safety system. While similar in many respects to fault tree analysis, MORT is more generalized and presents over 1500 specific elements of an ideal universal management program for optimizing occupational safety.

1362 **(DOE/SSDC—76-45/11-Rev.1) Risk-management guide.** Briscoe, G.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1982. Contract AC07-76ID01570. 226p. (SSDC—11-Rev.1). NTIS, PC A11/MF A01. Order Number DE84000492.

The role of risk assessment is to provide the necessary information to make decisions regarding the cost effective commitment of resources to accident prevention and reduction. Risk assessment can also be used to determine if a proposed action is acceptable in those situations where it is impractical to eliminate particular hazards. A limitation in this process is that estimates of future losses are necessarily based on probabilities, statistics, and even subjective judgment; and therefore can never be precise. The decision to allocate resources, thus, is always made in the face of uncertainty. The purpose of risk analysis is to reduce that uncertainty as much as practical by providing a framework for the incorporation of all available information regarding the costs and risks of various alternatives. This guide provides some methods for analyzing and presenting this data to management.

1363 **(DOE/SSDC—76-45/12) Safety considerations in evaluation of maintenance programs.** Nertney, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1978. Contract AC07-76ID01570. 22p. (SSDC—12). NTIS, PC A02/MF A01. Order Number DE84000493.

This guide is designed for the purpose of analyzing maintenance programs from the safety point of view. The necessary ana-

lytical trees are developed and converted to a series of analytical questions to be asked in safety evaluation of maintenance programs. The guide provides a further and more detailed development of maintenance considerations included in the basic management Oversight and Risk Tree (MORE). It also uses the same topic headings and is designed to interface with the Maintenance Managers Guide prepared by the Energy Research and Development Administration's (now the Department of Energy) Division of Construction Planning and Support.

1364 **(DOE/SSDC—76-45/13) Management factors in accident and incident prevention (including management self-evaluation checksheets).** Nertney, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1978. Contract AC07-76ID01570. 41p. (SSDC—13). NTIS, PC A03/MF A01. Order Number DE84002508.

This document is designed to provide a means for accident/incident prevention by familiarizing managers with management-related accident/incident causal factors which have been revealed in Department of Energy (DOE) supported accident investigation research. It also helps to prepare managers for the DOE investigative process by making the manager aware of those factors which will be investigated in a formal DOE accident investigation. Checklists are provided to assist the manager in determining his and his organization's state of readiness relating to accident prevention.

1365 **(DOE/SSDC—76-45/14-Rev.1) Events and causal factors charting.** Buys, J.R.; Clark, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1978. Contract AC07-76ID01570. 44p. (SSDC—14-Rev.1). NTIS, PC A03/MF A01. Order Number DE84000494.

The Events and Causal Factors (E and CF) chart (or diagram) depicts in logical sequence the necessary and sufficient events and causal factors for accident occurrence. It can be used not only to analyze the accident and evaluate the evidence during investigation, but also can help validate the accuracy of preaccident systems analyses. The E and CF sequence charting technique is an integral and important part of the MORT-based DOE accident investigation process. It is used in conjunction with other key MORT tools, such as MORT tree analysis, change analysis, and energy trace and barrier analysis, to achieve optimum results in accident investigation. E and CF charting has been used successfully as a focal point of analysis on several ERDA and DOE accident and incident investigations with excellent results. The fundamentals of this valuable MORT tool are discussed in this monograph. 9 references.

1366 **(DOE/SSDC—76-45/18) Safety-performance measurement system.** Nertney, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1979. Contract AC07-76ID01570. 14p. (SSDC—18). NTIS, PC A02/MF A01. Order Number DE84000497.

This report describes the Safety Performance Measurement System Model being used by the EG and G System Safety Development Center in design of environment, safety, and health information systems for the Department of Energy. The model relates the safety information inputs, the analytical processes and the system outputs to the management decision processes.

1367 **(DOE/SSDC—76-45/19) Job safety analysis.** Pavlov, P.V. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1979. Contract AC07-76ID01570. 43p. (SSDC—19). NTIS, PC A03/MF A01. Order Number DE84002515.

The concepts and techniques for the development and performance of an effective job safety analysis (JSA) are presented and discussed. The elements of an analytic tree are identified. These elements include management controls, identification of a method for job selecting, analysis of the job, incorporation of the JSA into operational systems and monitoring a JSA program. The contribution of employees based on their experience and knowledge is illustrated.

1368 **(DOE/SSDC—76-45/20) Management evaluation and control of release of hazardous materials.** Nertney, R.J.; Pavlov, P.V. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1980. Contract AC07-76ID01570. 20p. (SSDC—20). NTIS, PC A02/MF A01. Order Number DE84000500.

This manual describes the considerations involved in dealing with accidental releases of hazardous materials from operating plants and processes. It is intended to provide assistance in design and analysis of management control systems utilized in dealing with accidental releases having potential for significant environment, safety or health impact. This manual is a part of the Management Oversight and Risk Tree (MORT) program, but may be used independently of MORT for design and evaluation of programs used to deal with releases of hazardous materials.

1369 **(DOE/SSDC—76-45/21) Change control and analysis.** Bullock, M.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1981. Contract AC07-76ID01570. 55p. (SSDC—21). NTIS, PC A04/MF A01. Order Number DE84002516.

The purpose is to sensitize the user to the need for change control in on-going systems and the institution of safety-related counter-changes. It emphasizes the need for after-the-fact analyses of changes and differences as potential causal factors of accidents and incidents. It should provide managers, supervisors, and safety specialists with concepts, information, and techniques for use in the control and analysis of unwanted change. This document contains various change analysis worksheets to aid the user in the initial steps of change analysis. These worksheets intended as examples which might inspire the reader to do some creative thinking which will produce the needed job-related change control methods.

1370 **(DOE/SSDC—76-45/22) Reliability and fault tree analysis guide.** Crosetti, P.A. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Feb 1982. Contract AC07-76ID01570. 156p. (SSDC—22). NTIS, PC A08/MF A01. Order Number DE84002517.

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This guide was prepared to acquaint system managers, safety personnel, designers, and support personnel with reliability and fault tree analysis techniques. The guide also serves as an aid in applying these techniques within the Department of Energy's Management Oversight and Risk Tree (MORT) system safety context.

1371 **(DOE/SSDC—76-45/23) Safety appraisal guide for use with DOE Order 5482.1A.** Buys, J.R.; Nertney, R.J.; Bullock, M.G.; Klinestiver, L.K.; Knox, N.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1982. Contract AC07-76ID01570. 108p. (SSDC—23). NTIS, PC A06/MF A01. Order Number DE84002518.

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The DOE Environmental, Safety and Health (ES and H) appraisal program consists of internal audits, confirmatory management and functional appraisals, program reviews and assessments, and independent overview reviews and appraisals. The purpose of this guide is to implement the appraisal factors of DOE Order 5482.1A, Environmental Protection, Safety, and Health Protection Appraisal Program. It thereby provides a basis for appraisal in accordance with the DOE Order 5482.1A, which is free of oversights, and which has a well defined, standardized structure. Finally, this guide is used as a primary text and workbook in the DOE Appraisal Training Workshop, as well as in actual field appraisals which are an integral part of the total DOE Safety Performance Measurement System (SPMS).

1372 **(DOE/SSDC—76-45/24) Safety assurance system summary (SASS) manual for appraisal.** Letson, S.B.; Buys, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1982. Contract AC07-76ID01570. 151p. (SSDC—24). NTIS, PC A08/MF A01. Order Number DE84002519.

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Appraisal constitutes a knowledgeable judgement of the quality of system performance and, consequently, identifies both system strengths and system weaknesses. It is based upon a systematic, critical analysis of monitoring, audit, and other information gathering and processing practices; and application of appropriate criteria for evaluation of system effectiveness and program implementation, in accordance with applicable orders and directives. Systemic weaknesses and defects revealed through use of the Safety Assurance System Summary (SASS) must be evaluated by the appraiser in terms of potential Environmental, Safety, and Health (ES

and H) impact. The SASS is an evaluative tool to assist the appraiser in performing the appraisal task. It is useful in systematizing program appraisals, audits, and assessments. It can be used singly as the basic appraisal evaluative method; or can be employed as a generic checklist in meeting appraisal objectives dictated by specific appraisal orders or directives. The broad applicability of SASS results from its being specifically structured for appraisals; and its capability for providing a high degree of confidence in objectively and comprehensively evaluating system performance and developing factually based and valid recommendations or statements of need.

1373 **(DOE/SSDC—76-45/25) Effective safety review.** Buys, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1982. Contract AC07-76ID01570. 55p. (SSDC—25). NTIS, PC A04/MF A01. Order Number DE84000503.

Effective safety review is a key ingredient of a high-quality safety-assurance and loss-control program. It can be performed by independent reviewers or by monitored self-reviewers, acting in accordance with established criteria. It can be accomplished by individual reviewers or by established criteria. It can be accomplished by individual reviewers or by a review board, whichever best fits the review task. Reviewers, in either case, must be carefully selected on the basis of their managerial, technical, or review process capabilities and capabilities balance; their objectivity and independence; and their motivation to do the review task. Properly selected reviewers must be provided with appropriate review criteria in order to properly evaluate review inputs, carry out review activities, and arrive at meaningful, objective, reproducible findings, conclusions, and recommendations. The basic characteristics that reviewers and review criteria, inputs, activities and outputs must possess have been identified in this monograph and are common to all review types.

1374 **(LA—9778-MS) Evaluation of irritant smoke qualitative fitting test for respirators.** Marsh, J.L. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 18p. NTIS, PC A02/MF A01. Order Number DE84002291.

The results of a qualitative fit test, utilizing an irritant smoke, were compared with the results of a quantitative fit test utilizing an oil mist aerosol, for both half-mask and full-facepiece respirators. For a respirator-wearer combination having a fit factor less than 10, as determined by the quantitative test, the point estimate of the probability of that combination not being rejected by the irritant smoke qualitative test was found to be 0.00 with 95% confidence that this statistic will not exceed 0.08. For a respirator-wearer combination having a fit factor less than 100, the point estimate of the probability of that combination not being rejected by the qualitative test was found to be 0.04 with 95% confidence that this statistic will not exceed 0.08.

1375 **(NUREG/CR—2958) Expedient methods of respiratory protection. II. Leakage tests. Final report.** Cooper, D.W.; Hinds, W.C.; Price, J.M.; Weker, R.; Yee, H.S. (Harvard Univ., Boston, MA (USA). School of Public Health). Jul 1983. Contract AC04-76DP00789. 46p. (SAND—82-7084). NTIS, PC A03/MF A01 - GPO. Order Number DE84001184.

The following readily-available materials were tested on a manikin connected to a breathing simulator to determine the fraction of an approximately 2-μm-diameter aerosol that would leak around the seal of the materials to the manikin's face: cotton/polyester shirt material, cotton handkerchief material, toweling (a wash cloth), a surgical mask (Johnson and Johnson Co., model HRI 8137), and a NIOSH-approved disposable face mask (3M, model # 8710). The leakage tests were performed to supplement the measurements of penetration through the materials, conducted as the first phase of this investigation. The leakage tests were performed with the materials held on to the face by three methods, leakage fractions being determined from comparisons with the penetration of the same aerosol for the materials fully taped to the face. At a breathing rate of 37 liters per minute, mean leakages ranged from 0.0 percent to 63 percent. Mean penetrations exclusive of leakage ranged from 0.6 percent to 39 percent. Use of nylon hosiery material (panty hose) to hold the handkerchief material or the disposable face mask to the face was found to be very effective in preventing leakage. Such a combination could be expected to reduce leakage around the handkerchief to about ten percent or less in practice, and around the mask to less than one percent, offering substantial protection from accidentally generated aerosols. The reduction in leakage around the mask provided by the hosiery material suggests the adaptation and use of such an approach in regular industrial hygiene practice. The third and final phase of this investigation is underway, in which the penetration of the materials by particles with diameters between 0.05 and 0.5 μm is being measured and the effectiveness of the methods for dose reduction in the presence of radioactive aerosols is being modeled.

1376 **(NUREG/CR—3403) Criteria and test methods for certifying air-purifying respirator cartridges and canisters against radioiodine. Progress report, October 1, 1978-September 30, 1982.** Wood, G.O.; Valdez, F.O.; Gutschick, V. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 43p. (LA—9827-PR). NTIS, PC A03/MF A01. Order Number DE84002281.

A project has been completed which provides experimental data and recommendations for establishing a standard test procedure and acceptance criteria for air-purifying respirator cartridges and canisters used for airborne radioiodine. Previous experimental work with methyl iodide vapor was extended to generate elemental iodine and measure its removal by charcoals. A special apparatus was constructed and used to simultaneously measure penetrations of radioiodine and normal iodine vapor species through beds of various charcoals. Normal methyl iodide (I-27) was selected as the most representative vapor species for testing and its limitations were identified. Effects of testing and use conditions (bed depth, contact time, concentration, relative humidity, temperature, flow-rate, and flow cycling) were studied to identify testing requirements. Temperature and simulated breathing flow cycling were shown to have much more significance than was previously realized. Recommendations for testing and approval include considering the effects of all these parameters. An apparatus designed and built for testing has been delivered to the National Institute for Occupational Safety and Health. In one related study the desorption of triethylenediamine (TEDA), a charcoal impregnant for organic iodide removal, was found to be insignificant at normal canister use conditions. 17 references, 28 figures, 21 tables.

1377 **(PB—83-234096) NIOSH (National Institute for Occupational Safety and Health) program plan by program areas - FY 1983.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1983. 146p. NTIS, PC A07/MF A01.

The National Institute for Occupational Safety and Health is the major federal organization responsible for scientific research on the safety and health problems caused by work. Through the scientific activities of the Institute, it hopes to exercise a role of responsible leadership in the field of occupational safety and health. Each year since 1977, NIOSH has published a Program Plan which specifies in detail the scientific work planned for the Institute for the Fiscal Year. The Plan is the product of a systematic process which takes into account the specific national goals for prevention set by the United States Public Health Service and also the concerns of organizations who look to NIOSH for scientific leadership in protecting the health of workers. Particular attention is paid to requests from those agencies in the Department of Labor, principally OSHA and MSHA, responsible for regulating the workplace.

1378 **(UCID—19758-Rev.1) Contingency plan for the Lawrence Livermore National Laboratory, Site 300, hazardous waste operations. Revision 1.** Gonzalez, M.A.; Buerer, A.L. (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01. Order Number DE84002681.

This contingency plan for hazardous waste release provides guidance for coordinating response efforts at Site 300, Lawrence Livermore National Laboratory (LLNL). The goal of this plan is to minimize hazards to human health and life, and protect livestock, wildlife, the environment, and property in the event of a fire, explosion, or any unplanned release of hazardous substances or mixtures to the air, water, or soil. This plan includes: an overview of LLNL

Site 300's emergency response capabilities; and a description of responsibilities assigned to LLNL facility personnel and to LLNL and non-LLNL emergency response personnel.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 235, 236, 261, 269, 1190

1379 **(CONF-8310193—1) Base line for determining local, small-scale vertical movements in Louisiana.** Trahan, D.B. (Louisiana Geological Survey, Baton Rouge (USA)). 1983. Contract AC08-81NV10174. 20p. NTIS, PC A02/MF A01. Order Number DE84002569.

From Arizona Consulting Engineers Association land subsidence symposium; Phoenix, AZ, USA (21 Oct 1983).

Subsidence in Louisiana is a result of many factors ranging from local, man-induced to regional, large-scale processes. The measurement of local, man-induced subsidence is especially critical in areas with high rates of land loss. In order to measure local vertical movement, absolute historical geodetic movements have been estimated by adjusting all movements along the first-order vertical control network from northeast to southwest Louisiana as related to the Monroe Uplift. The adjustment will serve as a base line by which local subsidence or uplift can be measured. A generalized trend of increasing subsidence to the south in Louisiana is probably a reflection of increasing sediment thickness and weight toward the AXIS of the Gulf Coast Basin. Anomalous values as low as -17.6 mm/y occur superjacent to the position of Pleistocene and Holocene fluvial elements. Positive movement, up to +4.1 mm/y, has been found associated with the Iberian structural axis in south-central Louisiana. Land subsidence due to natural causes may far outweigh subsidence resulting from fluid withdrawal or depressurization of geopressured aquifers. The effects of regional and local natural processes should not be underestimated in any systematic approach to measuring subsidence. 13 references, 7 figures.

1380 **(N—8324923) Geologic setting of the Georges Bank Basin.** Schlee, J.S.; Klitgord, K.D. (Geological Survey, Washington, DC (USA)). 1982. 7p. NTIS, PC A09/MF A01.

In Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer Continental Shelf p 4-10 (SEE N83-24921 14-42).

Underlain by a wedge of Triassic and younger sedimentary rock that overlies rifted basement, the Georges Bank is tectonically a collection of smaller subbasins, some of which are linear grabens that trend northeast. Structurally, the basin is situated between the LaHave platform to the northwest, the Gulf of Maine platform to the north, and the Long Island platform to the west. The deepest, most restricted part of the basin may contain as much as 26,250 of Lower Jurassic and older nonmarine clastic rocks and evaporite deposits. The stratigraphy of the basin, as determined from rocks recovered from COST G-1 and G-2 wells is examined.

1381 **(UCRL—89226) Continental Scientific Drilling Program data base - 1983.** Pawloski, G.A.; Howard, N.W. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 18p. (CONF-8310192—2). NTIS, PC A02/MF A01. Order Number DE84002730.

From Geological Society of America annual meeting; Indianapolis, IN, USA (31 Oct 1983).

The Continental Scientific Drilling Program data base is a central repository cataloguing information on over 2000 government funded and scientifically interesting drill holes in the United States. Utilization of the data base can help reduce drilling costs and help maximize scientific value of drilling efforts by government agencies and industry.

5802 Geophysics

REFER ALSO TO CITATION(S) 585, 586, 587, 588, 1002, 1380

1382 **(LA—9899-PR) Earthquake catalog for northern New Mexico. Progress report, January-March 1983.** Cash, D.J.; Olsen, K.H.; Stewart, J.N.; Wolff, J.J. (Los Alamos National Lab., NM (USA)). Sep 1983. Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01. Order Number DE84002319.

This report is a summary of the earthquakes located in northern New Mexico by the Los Alamos National Laboratory seismic array. Data are presented in the form of tables and epicenter maps, with a brief explanatory text. 6 references, 4 figures, 2 tables.

1383 **(LBL—10145) Three-dimensional terrain effects in electrical and magnetometric resistivity surveys.** Oppliger, G.L. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 273p. NTIS, PC A12/MF A01. Order Number DE84001239.

Thesis.

Three-dimensional modeling of topographic effects in electrical resistivity and magnetometric resistivity surveys has been accomplished using the surface integral equation method. The technique provides a means for: (1) analyzing these effects on earth models of homogeneous conductivity and (2) removing terrain effects from field data. A new method combining current source images with surface charge is developed to treat the air-earth interface electric field boundary conditions. The topographic surface is modeled by a finite number of cells, each with constant slope and surface charge density. Charge values are obtained with an iterative solution technique. Surface electric fields are calculated from the surface charge distribution, current sources and images. The magnetic field is found by evaluating a surface integral involving surface slopes and electric fields. The numerical solution is verified by comparisons with dipole-dipole resistivity results from a two-dimensional finite element model of a valley and with analytic solutions for the magnetic fields over a dipping interface. Resistivity and magnetometric resistivity terrain effects are investigated by modeling a suite of 16 two- and three-dimensional terrain features. Finally, methods for removing terrain effects from apparent resistivity and magnetometric resistivity data are described and demonstrated with examples using actual field measurements. 22 references, 125 figures, 3 tables.

1384 **(LBL—16692) Inverse torsional eigenvalue problems.** Willis, C. (Lawrence Berkeley Lab., CA (USA)). Jun 1983. Contract AC03-76SF00098. 136p. NTIS, PC A07/MF A01. Order Number DE84002568.

Portions are illegible in microfiche products; Thesis.

We undertake a numerical and theoretical investigation of the inverse problem for the reconstruction of the density rho and S-wave velocity β of the Earth from its torsional oscillations. We assume a spherically symmetric, non-rotating Earth which consists of a perfect elastic, isotropic material and transform the differential equation governing the torsional oscillations to a Sturm-Liouville problem. We present a numerical method for determining rho and β in the upper mantle when rho and β are smooth functions of radius. The method, based on the Rayleigh-Ritz method, solves iteratively for the coefficients of a generalized Fourier series for the potential. We reconstruct several earth models to 2% accuracy. However, the method is sensitive to error in the data. This is not true of the inversion for the density alone and suggests that the simultaneous inversion for the density and velocity from free oscillation data may be unstable. The smoothness assumption is a serious limitation of our numerical method, since most earth models have a discontinuity at the crust and many have gradients with discontinuities in the upper mantle. We study the associated discontinuous Sturm-Liouville problem and prove that if the eigenfunctions have two discontinuities and if the potential is known in half the interval then the potential in the whole interval is uniquely determined from one spectrum. We apply this theorem to the discontinuous earth model to prove that given rho in the lower mantle and β in the mantle and crust, then the torsional spectra of one angular order

uniquely determine rho in the upper mantle. In addition, if β is known only in the lower mantle, then two torsional spectra uniquely determine both rho and β in the upper mantle.

1385 **(N—8324930) Geophysical studies of the COST Nos. G-1 and G-2 wells.** Taylor, D.J.; Anderson, R.C. (Geological Survey, Washington, DC (USA)). 1982. 1p. NTIS, PC A09/MF A01.

In Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer continental Shelf p 153-159 (SEE N83-24921 14-42).

Ditigal well log data from the COST Nos. G-1 and G-2 wells were used to compute subsurface velocities and synthetic seismograms. The interval-traveltime log from each well was integrated over each respective depth range, producing a relationship between depth and two-way traveltime for a seismic wave propagating through the subsurface. This relationship was used to convert the suite of well logs recorded as a function of linear depth to linear functions of time. The interval-traveltime log also privided other velocity information relevant to seismic reflection processing and interpretation. Synthetic seismograms were also computed using the velocity and density logs from the wells. The synthetic seismograms were bandpass filtered to match the seismic field data for correlation, and then spliced into the seismic line at the appropriate location.

1386 **(N—8324931) Basement structure, sedimentation and tectonic history of the Georges Bank Basin.** Klitgord, K.D.; Schlee, J.S.; Hinz, K. (Geological Survey, Washington, DC (USA)). 1982. 27p. NTIS, PC A09/MF A01.

In Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer Continental Shelf p 160-186 (SEE N83-24921 14-42).

A tectonic history is developed for the sediment-filled basins beneath Georges Bank by examining the crustal foundation beneath these basins and by outlining the stages in sedimentary buildup. The analysis of magnetic and gravity data integrated with seismic reflection profiles clues as to the nature of basement rocks, their depth of burial, composition, and tectonic setting. Interpretation of seismic reflection profiles and the correlation of seismic stratigraphic units with lithostratigraphic units at the COST Nos. G-1 and G-2 wells gives a history of basin filling over the past 200 m.y., including major trends in rock types and their thicknesses, relative ages of interregional unconformities and the relationship of the basin sedimentation to the construction of the adjacent continental slope and rise.

1387 **(UCRL—52000-83-9) Energy and technology review.** (Lawrence Livermore National Lab., CA (USA)). Sep 1983. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01. Order Number DE84001677.

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Topics covered include: reflection seismology at the Nevada test site; models of nonequilibrium nuclear reactions; and revealing subsurface structure with borehole gravimetry. (GHT)

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 197, 230, 260, 262, 1152

1388 **(BMI/OCRD—9) Expected repository environments in granite: assessment of rock stability of the container drill hole region.** Brandshaug, T. (RE/SPEC, Inc., Rapid City, SD (USA)). Oct 1983. Contract AC06-76RL01830;AC02-83CH10140. 47p. NTIS, PC A03/MF A01. Order Number DE84002553.

This report was prepared as part of a study on Expected Repository Environments in Granite (ERE-G). The repository regions considered in this report were the disposal room, the pillar between rooms, and the waste container drillhole. Three-dimensional analyses were performed to predict temperatures in the rock and to investigate the thermoelastic response and its effect on rock stability. Calculated factors-of-safety of intact rock identify zones of potential rock instability. The analyses were performed for three different types of waste: spent fuel (SF), commercial high-level waste (CHLW), and defense high-level waste (DHLW). The highest temperatures were predicted in the rock when considering CHLW and the lowest when considering DHLW. The analyses did not predict any rock instability as a consequence of excavating the room and the container drillhole. In all cases, relatively high tensile stresses develop in the upper part of the drillhole. The analyses give evidence of potential stability problems of the rock around the drillhole later in time for both the SF and the CHLW. In the case of DHLW, no instability of the rock was predicted during the time period considered in these analyses. 7 references, 24 figures.

1389 **(CONF-821199—) Forum on subsidence due to fluid withdrawals.** Donaldson, E.C.; van Domselaar, H. (eds.). (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA); INTEVEP, Filial de Petroleos de Venezuela, SA, Los Teques. Centro de Investigacion y Desarrollo). Aug 1983. 145p. NTIS MF A01. Order Number DE84001028.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

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This Forum on subsidence due to fluid withdrawal was convened to develop a better understanding of the global scope of subsidence, the current state of the theoretical understanding of the problem, and to ascertain and recommend areas where a multidisciplined approach to research could aid in the resolution of the problem. The papers presented at the Forum have been divided into four logical divisions: (1) definition of the problem of subsidence, (2) influence of special conditions on subsidence, (3) theories and mathematical models, and (4) discussions of field cases. An appendix containing transcripts of the discussions prepared by two specialists in rock mechanics and the research recommendations which were the final result of the Forum, have been added. All 14 papers have been abstracted and indexed for the Energy Data Base.

1390 (CONF-821199—, pp 25-32) **Compressibilities of sands and clays.** Chilingar, G.V.; Yen, T.F.; Rieke, H.H. III; Fertl, W.H. (Univ. of Southern California, Los Angeles). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The authors propose solutions to some difficulties that have developed through the use of different types of apparatus and methods of calculations for the determination of compressibilities. They state that numerous problems remain to be solved in the area since the various methods (uniaxial and hydrostatic) and procedures do not give corresponding data although they are designed to measure the same phenomena. They point out that compressibilities of sands obtained with hydrostatic apparatus are commonly twice as high as those obtained in uniaxial apparatus. Compressibility data are scarce and in many cases inaccurate, in spite of the fact that knowledge of compressibilities of sands and clays are important to the understanding of subsidence, abnormal formation pressures, and reservoir engineering. The authors propose solutions to some of the problems. 42 references, 4 figures.

1391 (CONF-821199—, pp 33-44) **Tectonic framework and detection of aquifers susceptible to subsidence.** Prokopovich, N.P. (Bureau of Reclamation, Sacramento, CA). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The author discusses subsidence in the San Joaquin Valley of California. The Valley is the world's largest single area affectd by subsidence caused by fluid withdrawal. Piezometric decline of the system has locally exceeded 135 meters, and maximum subsidence has approached 9 meters. Various forms of land subsidence can be separated according to their origin into two major genetic groups (1) endogenic subsidence which is related to processes that originate essentially within the plant, as tectonic movements, and (2) exogenic subsidence which is related to processes that originate near the earth's surface, such as processes related to human activity such as withdrawal of water, oil and gas, mining, etc. Exogenic subsidence is basically a surface expression of compaction of deposits at depth and is usually caused by an increase of actual or effective

loading. Susceptibility of a confined aquifer systems to subsidence due to aquifer compaction is not totally preconsolidated by the weight of overburden and is susceptible to subsidence following decline of piezometric head. 19 references, 14 figures.

1392 (CONF-821199—, pp 65-75) **Reservoir mechanics for geopressured-geothermal reservoirs.** Thompson, T.W.; Gray, K.E. (Univ. of Texas, Austin). Aug 1983. NTIS MF A01. Contract AC08-79ET27112.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The authors discuss abnormal geopressures from the point of view of reservoir mechanics. A series of mechanical test have been conducted on cores from a deep geopressured-geothermal reservoir. The rocks exhibit stress dependence in their short term response to load and can show time-dependent volume and deviatoric strains under applied hydrostatic stress and on pore pressure reduction. The results are discussed together with their significance to fluid production, compaction and surface subsidence. 26 references, 14 figures, 2 tables.

1393 (CONF-821199—, pp 80-85) **Update of the theories to investigate subsidence.** Saxena, S.K. (Illinois Inst. of Tech., Chicago). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

According to the author, the subsidence due to removal of a fluid is basically due to fluid flow out of the ground and heat flow in limited cases of geothermal-geopressure source. The major problems in the evaluation of subsidence are many. The fluid may exist in both the water and stream phases and their concentration in each phase may vary with time and location. The second major point is that the deformation of the porous solid is often irreversible and depends on the geological history of the deposit. The deformation properties of the solids vary with saturation, temperature and many variables. The most difficult part of the investigation is the understanding of in situ behavior from the samples obtained by relatively crude methods. The author highlights the available theories to evaluate subsidence, critically reviews them, and discusses the merits and demerits of each. 31 references, 2 figures.

1394 (CONF-821199—, pp 86-92) **Practical evaluation of subsidence models for fluid withdrawal.** Barends, F.B.J.; Heijnen, W.J. (Delft Soil Mechanics Lab., Netherlands). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

The investigators discuss analytic formulations of subsidence on the basis of experience in the Netherlands. The gradual increase of oil/water recovery to meet the growing demand made land subsidence manifest recently as a serious environmental problem in coastal and wetland areas. In the Netherlands the geological system is usually complex. Acquired data are mostly insufficient or irrelevant to simulate the subsidence phenomenon properly. Existing sophisticated models do not cover essential aspects of compaction and consolidation including non-linear effects, but the link to practice is weak. Fundamental parameters can only be roughtly estimated. An approach is suggested which focuses on efficiency by adopting and analytical formulation of the consolidation/deformation process explicitly in terms of reservoir pressures, which in turn are determined numerically in order to account for hetergeneity in the geological system. Whereas the true coupling between both is established iteratively. Using this approach integration in time is not required, reducing the cost of long term prediction drastically. Adjustments from geological information and alternation in production strategy are easily incorporated. This model meets practical requirements. The application to a typical environmental problem in the dutch polder area elucidates a promising improvement to prediction of subsidence behavior. 20 references, 4 figures.

1395 (CONF-821199—, pp 93-96) **Fluid withdrawal from an anisotropic, compressible porous media.** Evans, R.D. (Univ. of Oklahoma, Norman). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

A mathematical model has been proposed which may be used to predict land subsidence and reservoir compaction assuming reasonable fluid and rock properties for a given area are available as inputs to the model. It is suggested that this model be utilized as a starting point and test its validity against known subsidence and compaction data that are currently available in the literature. Both finite element and finite difference numerical schemes should be utilized as a starting point for solving the equations in question. Simultaneously other analytical, semi-analytical and other numerical approaches should be pursued in order to arrive at a satisfactory model for making reasonable land subsidence and reservoir compaction predictions. 19 references.

1396 (CONF-821199—, pp 97-107) **Finite element analysis of subsidence due to fluid withdrawal.** Sandhu, R.S. (Ohio State Univ., Columbus). Aug 1983. NTIS MF A01.

From Conference on subsidence due to fluid withdrawal; Checotah, OK, USA (14 Nov 1982).

This paper briefly reviews mathematical models of subsidence associated with fluid withdrawal and application of the finite element method to obtain approximate solutions to the problem. Since the first application of the method to analysis of fluid flow in porous deformable media in 1968, considerable progress has been made in the theoretical formulation as well as the computational procedures. Recent advances include variational formulations admitting limited smoothness of finite element bases, experimentation with several different spatial interpolation schemes and investigation of various temporal approximation methods. The finite element method has been applied to flow in viscoelastic media and to finite deformation. Developments in solution procedures include use of Laplace transforms, automatic selection of time-step size and the use of single variable formulations. Improvements in solution procedure to avoid oscillations and errors in solution have included smoothing through the use of reduced integration. Other developments cover use of boundary element methods, allowance for infinitely-distant boundaries, material interfaces, etc. Prior to the recent developments in numerical solution of the problem, certain simplified models were extensively used. In view of the availability of effective solution procedures for the coupled problem of fluid flow and deformation of porous media, to resort to drastic simplification, which might lead to incorrect results, appears unnecessary. 122 references, 2 figures.

1397 (DOE/BETC/RI—83/7) **Comparison and analysis of reservoir rocks and related clays.** Crocker, M.E.; Donaldson, E.C.; Marchin, L.M. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1983. 28p. NTIS, PC A03/MF A01. Order Number DE84002021.

A series of instrumental and chemical analyses was made on sedimentary rocks to determine the surface chemical properties of sedimentry rocks and the physical characteristic of the pores. A scanning electron microscope (SEM) with energy dispersive X-ray analytic capability was used to study the morphology of the samples, surface mineral composition and type and location of clays, and to obtain a qualitative estimate of the pore sizes. A centrifuge was used to determine the pore size distributions which are correlated with SEM observations. An atomic absorption spectrophotometer equipped with an inductively coupled plasma for complete spectral analysis was used to obtain analyses of the rocks, clays, and effluents from ion exchange tests. Two of the results are as follows: (1) Sweetwater gas sands have a bimodal pore size distribution composed of pores with a mean diameter of 0.2 microns which is attributed to intergranular spaces and cracks in the expanded laborboratory sample but which will be close under the pressure of the overburden formations, and these Sweetwater sands have a distribution of pores at 2 microns which are solution vugs rather than intergranular porosity since the sand grains are completely packed together with the cementing material due to the high overburden pressures; and (2) Ion-exchange capacities of two rocks were 5.3 meq/kg and 18.0 meq/kg, and the surface areas were 0.9 m^2/g and 2.30 m^2/g, respectively, even though each had almost identical mineral composition, clay type and quantity, and permeability. 7 references, 12 figures, 3 tables.

1398 (DOE/ER/10840—3, pp 28p, Paper VI) **Some considerations on studies of the mechanical behavior of rocks.** Cyrul, T. 1983. NTIS, PC A07/MF A01.

In Anisotropic elasticity of coals. Progress report, 1 October 1982-30 September 1983.

This paper presents fundamentals of the description of rocks structure. Classifications of heterogeneity of rocks were cited. Known probabilistic models of additive and nonadditive quantities were recalled. Mutual relationships of heterogeneity and anisotropy were discussed. Possible directions of research to more effeictively characterize rock behavior were formulated. Though not clearly stated because of the nature of rocks, the author favors statistical methods of study of rock behavior. 20 references, 1 table.

1399 **(MINTEK-M—85) List of unrestricted MINTEK publications issued from 1966 to 1982.** Glen, H.W. (Council for Mineral Technology, Randburg (South Africa)). 31 Mar 1983. 169p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE84900089.

This report is a compilation of all the publications of the National Institute for Metallurgy (NIM) and its successor, the Council for Mineral Technology (Mintek), having an unrestricted distribution list. The NIM reports end with Report 2135, and the Mintek reports start with Report M1. The present report includes all the unrestricted reports and the patents issued and registered by these organizations from 1966 to 31st December, 1982, the confidential reports that were declassified during that period, all the papers published during that period where one of the authors was, or is, a member of staff, and the other technical publications that do not fall into the categories already mentioned. The total number of unrestricted reports included is 834, the patents amount to 41, the number of papers published is 449, and the other technical publications amount to 4. This report also gives details of the periodical issued by Mintek and concludes with a list of miscellaneous publications, which are additional to those mentioned above. These include the current annual report, together with brochures and leaflets of various kinds.

1400 **(RHO-BW-SA—295-P) Composition of augite and pigeonite in basalt flows that are candidates for a nuclear waste repository.** Long, P.E.; Strope, M.B. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Aug 1983. Contract AC06-77RL01030. 7p. (CONF-830815—12). NTIS, PC A02/MF A01. Order Number DE84001111.

From 18. annual Microbeam Analysis Society conference; Phoenix, AZ, USA (8 Aug 1983).

The abundance and composition of pigeonite are variable within single flows of basalt in spite of uniform bulk composition. These variations are spatially related to the occurrence of entablature and colonnade, which in turn apparently reflect the cooling history of the flow. Differences from one flow to another in the occurrence of pigeonite may be explained by the extent to which early-formed microphenocrysts of pigeonite react out during crystallization of the flow and the extent to which late-stage pigeonite rims are developed. The preservation of pigeonite in the entablature of flows such as the Umtanum tends to corroborate the proposed origin of entablatures and their attendant fracture patterns by relatively rapid cooling of the interior of these flows.

1401 **(SAND—83-0535C) Proposed model for the thermal conductivity of dry and water-saturated tuff.** Moss, M.; Haseman, G.M. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 9p. (CONF-831174—4). NTIS, PC A02/MF A01. Order Number DE84002049.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

The room-temperature thermal conductivities of two kinds of tuff from the Nevada Test Site have been measured on a linear-heat-flow thermal comparator. The results are the basis for an empirical model of the conductivity of these rocks in the dry and water-saturated conditions as a function of porosity. Tuff is one medium being considered for nuclear waste disposal. Devitrified, non-zeolitized tuffs with 6 to 22% porosity, and non-welded, zeolitized tuffs with 24 to 35% porosity were examined. The empirical geometric mean model is used to characterize the porosity-dependent thermal conductivity. We consider the rock metrix conductivity and the effective fluid conductivity as adjustable parameters in fitting the model to data for saturated and dehydrated samples, separately. For each rock type, the fitted value of matrix conductivity is the same in both the saturated and dehydrated cases; 2.3 and 1.1 W/(m.K) for the non-zeolitized and zeolitized tuffs, respectively. The fitted values for fluid conductivites are different for the zeolitized and non-zeolitized tuffs, but the ratio of fitted water conductivity to fitted gas conductivity is very nearly the same for both rock types. This permits the use of a single equation to predict with good accuracy the ratio of saturated to dry rock conductivity.

1402 **(SAND—83-1590) Microcrack damage model of brittle rock.** Costin, L.S. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01. Order Number DE84002088.

In this report, some extensions and improvements of a recently proposed model which describes stress and time-dependent microcrack growth in brittle rock are discussed. The model is extended to a fully three dimensional description of damage nucleation and growth. In addition, a vectorial description of the damage induced by microcrack growth is proposed. Several improvements in the description of crack growth on the microscale are also discussed. These improvements lead to a development of damage surfaces (surfaces of constant damage in stress space) which is in good agreement with the results of recent experiments in which acoustic emissions were used to trace the progression of damage surfaces in a brittle rock deformed under triaxial compression. Finally, a failure criterion for brittle rock based on the concept of critical damage is proposed and discussed in detail. Several examples of model calculations under a variety of stress states and histories are presented. 27 references, 17 figures.

1403 **(USGS-OFR—83-642) Explosion-induced stress changes estimated from vibrating-wire stressmeter measurements near the Mighty Epic event, Nevada Test Site.** Ellis, W.L.; Kibler, J.D. (Geological Survey, Denver, CO (USA); USDOE Nevada Operations Office, Las Vegas). 1983. Contract AI08-76DP00474. 28p. NTIS, PC A03/MF A01. Order Number DE84002023.

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Explosion-induced compressive stress increases near an underground nuclear explosion are believed to contribute significantly to the containment of high-pressure gases within the explosion-produced cavity. These induced compressive stresses are predicted by computer calculations, but have never been adequately confirmed by field measurements, owing primarily to the unique difficulties of obtaining such field data. Vibrating-wire stressmeter measurements made near the Mighty Epic nuclear detonation, however, qualitatively indicate that within 150 meters of the working point, permanent compressive stress increases of several megapascals were present 15 weeks after the event. Additionally, stress-change magnitudes interpreted from the stressmeter data between the 75- and 260-meter range from the working point compare favorably with calculational predictions of the stress changes believed to be present shortly after detonation of the event. The measurements and calculations differ, however, with regard to the pattern of stress change radial and transverse to the explosion source. For the range of the field measurements from the working point, computer models predict the largest compressive-stress increase to be radial to the explosion source, while the field data indicate the transverse component of stress change to be the most compressive. The significance of time-dependent modification of the initial explosion-induced stress distribution is, however, uncertain with regard to the comparison of the field measurements and theoretical predictions.

1404 **Evidence for correlation of ultrasonic attenuation and fluid permeability in very low porosity water-saturated rocks.** Berryman, J.G.; Bonner, B.P.; Chin, R.C.Y. (Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, CA 94550). *Geophysical Research Letters;* **10**: No. 7, 595-598(Jul 1983).

The measured amplitude A of ultrasonic pulses in intact and fractured samples of water-saturated gabbro and granite is observed to decrease as the permeability κ increases according to the proportionality Aproportionalκ/sup -1/2/. This relation is predicted by Biot's theory of elastic waves in fluid-saturated porous media and, therefore, suggests that Biot's attenuation mechanism may play a significant role in low porosity materials at ultrasonic frequencies.

The evidence is not conclusive. The limited data set studied here is also consistent with correlations of the form Aproportionalκ/sup - Epsilon/ where 0.2<Epsilon<0.6. Nevertheless, the observed correlations may still provide a means for monitoring changes in permeability of low-porosity underground repositories of radioactive waste.

5804 Geochemistry

REFER ALSO TO CITATION(S) 1397

1405 **(UCRL—53414) EQ3NR: a computer program for geochemical aqueous speciation-solubility calculations. User's guide and documentation.** Wolery, T.J. (Lawrence Livermore National Lab., CA (USA)). 18 Apr 1983. Contract W-7405-ENG-48. 202p. NTIS, PC A10/MF A01. Order Number DE84001842.

EQ3NR is a geochemical aqueous speciation-solubility FORTRAN program developed for application with the EQ3/6 software package. The program models the thermodynamic state of an aqueous solution by using a modified Newton-Raphson algorithm to calculate the distribution of aqueous species such as simple ions, ion-pairs, and aqueous complexes. Input to EQ3NR primarily consists of data derived from total analytical concentrations of dissolved components and can also include pH, alkalinity, electrical balance, phase equilibrium (solubility) constraints, and a default value for either Eh, pe, or the logarithm of oxygen fugacity. The program evaluates the degree of disequilibrium for various reactions and computes either the saturation index (SI = log Q/K) or thermodynamic affinity (A = -2.303 RT log Q/K) for minerals. Individual values of Eh, pe, equilibrium oxygen fugacity, and Ah (redox affinity, a new parameter) are computed for aqueous redox couples. Differences in these values define the degree of aqueous redox disequilibrium. EQ3NR can be used alone. It must be used to initialize a reaction-path calculation by EQ6, its companion program. EQ3NR reads a secondary data file, DATAl, created from a primary data file, DATA0, by the data base preprocessor, EQTL. The temperature range for the thermodynamic data in the file is 0 to 300°C. Addition or deletion of species or changes in associated thermodynamic data are made by changing only the file. Changes are not made to either EQ3NR or EQTL. Modification or substitution of equilibrium constant values can be selected on the EQ3NR INPUT file by the user at run time. EQ3NR and EQTL were developed for the FTN and CFT FORTRAN languages on the CDC 7600 and Cray-1 computers. Special FORTRAN conventions have been implemented for ease of portability to IBM, UNIVAC, and VAX computers.

5805 Oceanography

REFER ALSO TO CITATION(S) 1244

1406 **(DOE/EV/71025—64) Pollutant transfer and sediment dispersal in the Washington-Oregon coastal zone. Report of progress, 1 August 1982-31 July 1983.** Hickey, B.M. (comp.). (Washington Univ., Seattle (USA). Coll. of Ocean and Fishery Sciences). 30 Jul 1983. Contract AT06-76EV71025. 14p. (RLO—2225-TA25-64). NTIS, PC A02/MF A01. Order Number DE84001506.

The goal is to gain an understanding of, and subsequently to generate accurate physical models for, large-scale circulation, boundary layer exchange dynamics, sediment transport, and animal-sediment interactions in the Pacific Ocean coastal waters of the northwest United States. Progress is reported in current measurements, investigations of the effects of variable topography on circulation, analysis of upwelling data, and in sediment transport studies. (ACR)

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 1115, 1557

1407 **(INPE—2013) Latitude variation of the diffuse component of the mean energy gamma radiation.** Espirito Santo, C.M. do. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Mar 1981. 133p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83704275.

For determining the diffuse component of gamma ray in the 15 to 75 MeV range arriving from near the galactic center, a digitized spark chamber was launched aboard two balloons from Resende, Brazil on 19 November and 3 December 1975. In each flight the detector reached an altitude of 2,2 $g.cm^{-2}$. Based on these data, we obtained a diffuse gamma ray flux 6,0 x 10^{-5}, 2,0 x 10^{-5}, 4,6 x 10^{-6} and 1,3 x 10^{-6} photons/cm^2.s.sterad.MeV at energies of 21, 36, 52 and 67 MeV respectively. These values give a power law spectrum with spectral index equal to - 3,3. The dependence of this radiation with the galactic latitude and longitude in the interval - 5° <= b sup(II)<= 35° and 325° <= 1 sup(II) <= 375° was also obtained. Finally, results obtained were compared with other experimenters' results.

1408 **(ITEP—127(1982)) Giant X-ray source in Cygnus (Cygnus superbubble) as a remnant of a peculiar supernova.** Blinnikov, S.I.; Imshennik, V.S.; Utrobin, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704277.

Paper copy only, copy does not permit microfiche production6 refs.; 1 fig.

The analytic solution of equations for the evolution of supernova remnants in the radiative phase is found. It shows that the X-ray source Cygnus Superbubble might be formed by an explosion with the energy release 10^{52}-10^{53} erg. The analysis of the light curve of SN 1961 shows that this supernova in the result of an explosion with energy about $2x10^{52}$ erg in a supermassive star with the mass of order $10^3 M_*$ where M_* is the solar mass. An evolutionary sequence for the formation of giant shell sources is suggested: presupernova - an object of the type R136a, supernova - an explosion of the type SN 1961 and the supernova remnant - a source of the type Cygnus Superbubble.

1409 **(ITF—82-89-R) Theory of X-ray emission from the extended galactic source Monogem Ring in monoceros constellation.** Krol', V.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1982. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704278.

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Theoretical description of X-ray radiation from Monogem Ring source in Monoceros based on involving thermal bremsstrahlung of optically transparent hot interstellar gas filling all the huge volume of a superbubble as a main mechanism of X-ray generation is developed. Obtained is analytical description of X-ray spectrum dependence on physical parameters of burst of Monoceros hypothetical supernova (possible original mother of pulsar PSR0656+14) and its remnants as well as from physical parameters characterizing interstellar medium before burst. Resulting formulae are suitable for numerical calculations of spectrum from extremely extended galactic sources of the Monogem Ring type. The results obtained promote elucidation the X-ray radiation nature from the investigated class of sources and can be of great importance in many applications (for example, when studying the nature of background X-ray radiation in the low energy range ($h\nu <$ or approximately 1 keV), when investigating activity of galaxy nuclei and cascade processes of star formation.

1410 **(LA-UR—83-2657) 3-10 keV and 0.1- to 2-MeV observations of four gamma-ray bursts.** Laros, J.G.; Evans, W.D.; Fenimore, E.E.; Klebesadel, R.W.; Shulman, S.; Fritz, G. (Los Alamos National Lab., NM (USA); Naval Research Lab., Washington, DC (USA); Sachs/Freeman Associates, Inc., Bowie, MD (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-830797—5). NTIS, PC A02/MF A01. Order Number DE84001334.

From Workshop on high energy transients; Santa Cruz, CA, USA (11 Jul 1983).

Four catalogued γ-ray bursts that occurred between 79/3/7 and 79/7/31 have been observed over the 3 to 10 keV range by a joint NRL/Los Alamos experiment on the Air Force P78-1 satellite. The bursts were also well observed by members of the interplanetary network. In this paper we present hardness ratios, x-ray/γ-ray luminosity ratios, and time histories. The most significant results presented herein can be summarized as follows: (1) gamma-ray bursters can emit fairly strongly at x-ray energies near the time of the γ burst with L/sub x//L/sub γ/ ~ .02 (L/sub x/ ~ 10^{37} ergs s^{-1}, 3 to 10 keV, assuming a distance of 1 kpc); (2) the centroid of the x-ray emission generally lags the γ-ray centroid, but there is also evidence for one or more types of x-ray precursor activity; (3) the γ-ray hardness ratios were not highly variable for these particular events. However, there is some evidence that the γ-ray spectra softened near the ends of the bursts when the x-ray/γ-ray ratios were high; (4) the x-ray/γ-ray power law number index during times of the strongest γ-ray emission ranged from 0.8 to ~ 1.1 for the four bursts; (5) the x-ray tail of GB790307 probably can be modeled as the cooling of hot plasma generated during the γ-ray burst. Simple versions of this model can be used to estimate various source parameters. These estimates imply a distance of a few hundred to a few thousand pc; (6) gamma-ray bursters probably do not produce events similar to classical x-ray bursts independently of the γ-ray emission.

1411 **(LA-UR—83-2744) Theoretical calculation of rapid x-ray transients and radius expansion.** Starrfield, S.; Sparks, W.; Truran, J.; Kenyon, S. (Arizona State Univ., Tempe (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Illinois Univ., Urbana (USA). Dept. of Astronomy). 1983. Contract W-7405-ENG-36. 4p. (CONF-830797—2). NTIS, PC A02/MF A01. Order Number DE84001312.

From Workshop on high energy transients; Santa Cruz, CA, USA (11 Jul 1983).

We present a calculation of a thermonuclear runaway on a 10 km neutron star which produces two x-ray bursts separated by ~ 2500 sec.

1412 **(LA-UR—83-2930) Some observable indicators of s-process environments.** Despain, K.H. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 4p. (CONF-8309172—2). NTIS, PC A02/MF A01. Order Number DE84001720.

From IAU symposium on observational tests of stellar evolution theory; Geneva, Switzerland (12 Sep 1983).

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By definition, the chemically peculiar stars have element abundances that are non-solar. Many of these stars show peculiarities in s-process elements. This paper discusses observable indicators of the neutron environment for the s-process in these stars.

1413 **(LA-UR—83-2969) Role of the radiation pressure gradient in giant and supergiant star evolution.** Brunish, W.M.; Cox, A.N.; Becker, S.A.; Despain, K.H. (Los Alamos National Lab., NM (USA)). 7 Oct 1983. Contract W-7405-ENG-36. 4p. (CONF-8309172—3). NTIS, PC A02/MF A01. Order Number DE84001715.

From IAU symposium on observational tests of stellar evolution theory; Geneva, Switzerland (12 Sep 1983).

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Since some of the earliest evolutionary calculations it has been found that post main sequence stars become red giants (e.g. Sandage and Schwarzschild, 1952). However the exact physical processes that lead to and determine the rate of redward evolution are not completely understood. We hypothesized that the redward evolution might be due to an increase in radiation pressure somewhere in the star that causes the layers above it to be pushed outward, resulting in an expanded envelope and a cooler surface temperature. If the radiative luminosity somewhere in the star approached the Eddington limit, the outer layers would obviously expand. However, due to the presence of gas pressure, the critical value for expansion would be somewhat less than the Eddington limit.

1414 **(N—8324434) Solar maximum mission: Ground support programs at the Harvard Radio Astronomy Station. Final Report.** Maxwell, A. (Harvard Radio Astronomy Station, Fort Davis, TX (USA)). Mar 1983. 22p. (NASA-CR—170267). NTIS, PC A02/MF A01.

Observations of the spectral characteristics of solar radio bursts were made with new dynamic spectrum analyzers of high sensitivity and high reliability, over the frequency range 25-580 MHz. The observations also covered the maximum period of the current solar cycle and the period of international cooperative programs designated as the Solar Maximum Year. Radio data on shock waves generated by solar flares were combined with optical data on coronal transients, taken with equipment on the SMM and other satellites, and then incorporated into computer models for the outward passage of fast-mode MHD shocks through the solar corona. The MHD models are non-linear, time-dependent and for the most recent models, quasi-three-dimensional. They examine the global response of the corona for different types of input pulses (thermal, magnetic, etc.) and for different magnetic topologies (for example, open and closed fields). Data on coronal shocks and high-velocity material ejected from solar flares have been interpreted in terms of a model consisting of three main velocity regimes.

1415 **(N—8324435) Observations of magnetic fields on solar-type stars.** Marcy, G.W. (Lick Observatory, Santa Cruz, CA (USA)). 1982. 73p. (NASA-CR—170296). NTIS, PC A04/MF A01.

Magnetic-field observations were carried out for 29 G and K main-sequence stars. The area covering-factors of magnetic regions tends to be greater in the K dwarfs than in the G dwarfs. However, no spectral-type dependence is found for the field strengths, contrary to predictions that pressure equilibrium with the ambient photospheric gas pressure would determine the surface field strengths. Coronal soft X-ray fluxes from the G and K dwarfs correlate well with the fraction of the stellar surface covered by magnetic regions. The dependence of coronal soft X-ray fluxes on photospheric field strengths is consistent with Stein's predicted generation-rates for Alfven waves. These dependences are inconsistent with the one dynamo model for which a specific prediction is offered. Finally, time variability of magnetic fields is seen on the two active stars that have been extensively monitored. Significant changes in magnetic fields are seen to occur on timescales as short as one day.

1416 **(UCRL—88720) Radiation transport in numerical astrophysics.** Lund, C.M. (Lawrence Livermore National Lab., CA (USA)). Feb 1983. Contract W-7405-ENG-48. 35p. (CONF-8210111—3). NTIS, PC A03/MF A01. Order Number DE84002011.

From Numerical astrophysics meeting (in honor of Jim Wilson's 60th birthday); Urbana, IL, USA (21 Oct 1982).

In this article, we discuss some of the numerical techniques developed by Jim Wilson and co-workers for the calculation of time-dependent radiation flow. Difference equations for multifrequency transport are given for both a discrete-angle representation of radiation transport and a Fick's law-like representation. These methods have the important property that they correctly describe both the streaming and diffusion limits of transport theory in problems where the mean free path divided by characteristic distances varies from much less than one to much greater than one. They are also stable for timesteps comparable to the changes in physical variables, rather than being limited by stability requirements.

1417 **(UCRL—89811) Problems in astrophysical radiation hydrodynamics.** Castor, J.I. (Lawrence Livermore National Lab., CA (USA)). 14 Sep 1983. Contract W-7405-ENG-48. 44p. (CONF-8207100—1). NTIS, PC A03/MF A01. Order Number DE84000185.

From Workshop on astrophysical radiation hydrodynamics; Munich, F.R. Germany (1 Jul 1982).

The basic equations of radiation hydrodynamics are discussed in the regime that the radiation is dynamically as well as thermally important. Particular attention is paid to the question of what constitutes an acceptable approximate non-relativistic system of dynamical equations for matter and radiation in this regime. Further discussion is devoted to two classes of application of these ideas. The first class consists of problems dominated by line radiation, which is sensitive to the velocity field through the Doppler effect. The second class is of problems in which the advection of radiation by moving matter dominates radiation diffusion.

1418 **(UCRL—89892) Theory of optical flashes.** London, R.A. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1983. Contract W-7405-ENG-48. 12p. (CONF-830797—6). NTIS, PC A02/MF A01. Order Number DE84001450.

From Workshop on high energy transients; Santa Cruz, CA, USA (11 Jul 1983).

The theory of optical flashes created by x- and γ-ray burst heating of stars in binaries is reviewed. Calculations of spectra due to steady-state x-ray reprocessing and estimates of the fundamental time scales for the non-steady case are discussed. The results are applied to the extant optical data from x-ray and γ-ray bursters. Finally, I review predictions of flashes from γ-ray bursters detectable by a state of the art all-sky optical monitor.

1419 **Estimating the tumble rates of galaxy halos.** Simonson, G.F.; Tohline, J.E. (Yale University Observatory, and Theoretical Division Los Alamos National Laboratory). *Astrophysical Journal;* **268**: No. 2, 638-645(15 May 1983).

It has previously been demonstrated that cold gas in a static spheroidal galaxy will damp to a preferred plane, in which the angular momentum vector of the gas is aligned with the symmetry axis of the potential, through dissipative processes. We show now that, if the same galaxy rigidly tumbles about a nonsymmetry axis, the preferred orientation of the gas can become a permanently and smoothly warped sheet, in which rings of gas at large radii may be fully orthogonal to those near the galaxy's core. Detailed numerical orbit calculations closely match an analytic prediction made previously for the structure of the warp. This structure depends primarily on the eccentricity, density profile, and tumble rate of the spheroid. We show that the tumble rate can now be determined for a galaxy containing a significantly warped disk. Ordinary observations used in conjunction with graphs such as those we present, yield at least firm lower limits to the tumble periods of these objects. We have applied this method to the two peculiar systems NGC 5128 and NGC 2685 and found that, if they are prolate systems supporting permanently warped gaseous disks, they must tumble with periods near 5×10^9 yr and 2×10^9 yr respectively. In a preliminary investigation, we also find that the massive, unseen halos surrounding spiral galaxies must tumble with periods longer than or on the same order as those of the elliptical galaxies.

1420 **On the interpretation of gamma-ray burst continua and possible cyclotron absorption lines.** Fenimore, E.E. (Los Alamos National Lab., NM); Laros, J.G. pp 201-209 of Gamma ray transients and related astrophyscial phenomena. New York, NY; American Institute of Physics (1982). (CONF-810871—).

From Workshop on gamma ray transients and related astrophysical phenomena; La Jolla, CA, USA (5 Aug 1981).

It is pointed out that most gamma-ray bursts have spectra that are fit by an optically thin thermal bremsstrahlung shape. The small emitting volume implied by the observation of spectral features identified as cyclotron absorption lines from a 10 to the 12th Gauss field is shown to prevent thermal bremsstrahlung from providing sufficient luminosities to account for the observed fluxes unless the optical depth to Compton scattering is large. It is also demonstrated that complicated detector response functions can introduce artifacts that mimic absorption features below 60 keV unless the absolute gain of the detector is established and correctly applied in analysis. Comparing the continuum as observed by the Berkeley/Los Alamos ISEE-3 gamma-ray detector with the continuum observed by the Konus (Mazets et al. 1981) experiments, a lack of agreement is found, suggesting that the gain of one of these experiments may be incorrect.

1421 **Emission mechanisms of the March 5th 1979 gamma ray transient.** Liang, E.P.T. (Univ. of California, Livermore). pp 241-248 of Gamma ray transients and related astrophysical phenomena. New York, NY; American Institute of Physics (1982). (CONF-810871—). Contract W-7405-ENG-48.

From Workshop on gamma ray transients and related astrophysical phenomena; La Jolla, CA, USA (5 Aug 1981).

This paper reviews the spectral and temporal constraints on the emission mechanisms of the initial burst and subsequent pulses of the March 5, 1979 gamma-transient. Interpretation of the hard tail above 300 keV as due to inverse comptonization, when combined with the synchrotron-pair annihilation model of Ramaty et al. (1981), makes it possible to derive from first principles the intrinsic luminosity of the source. This is in general agreement with that expected from N49 in LMC. The pulsed emissions have characteristics difficult to explain in terms of conventional models.

6402 Atmospheric Physics

1422 **(AD-A—130466/6) Currents in the earth's magnetotail. Report for period ending 1978.** Frank, L.A.; Huang, C.Y.; Eastman, T.E. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Mar 1983. 33p. NTIS, PC A03/MF A01.

Currents in the earth's magnetotail are detected with the plasma instrumentation on board the ISEE-1 spacecraft. Field-aligned currents directed into and out of the ionosphere are found in the boundary layer of the plasma sheet. Typical current densities are in the range of 5 X 10-9 to 5 X 10-8 A/m2. These currents are associated with the Region 1 current system that is observed previously at low altitudes. An intense current sheet is shown to exist at a discontinuity in convection electric fields ($V.E < 0$) during a period of great magnetic activity. Electron acceleration, similar to that for electron inverted-V precipitation regions at low altitudes, occurs in this current sheet. Examination of the plasma velocity distributions at a neutral-sheet crossing reveals that the neutral sheet current is carried by electrons and protons. The relative directions for the bulk flows of the proton and electron plasmas indicate that the first adiabatic invariant is not conserved for the protons, and quite possibly for the electrons also. These letter findings are in substantial agreement with a neutral sheet model for acceleration of charged particles in the presence of a weak electric field.

1423 **(AD-A—130467/4) High-altitude observations of an intense inverted-V event. Report for period ending May 78.** Huang, C.Y.; Frank, L.A.; Eastman, T.E. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Apr 1983. 35p. NTIS, PC A03/MF A01.

Inverted-V events which generally occur in the pre-midnight sector over the auroral zone are frequently associated with reversals in the convection electric field. Such a reversal is observed by the University of Iowa quadrispherical LEPEDEA on board ISEE-1 at an altitude of 13 RE on 1 May 1978. The bulk of the plasma shows a large shear over a five-minute interval. The associated change in the convection electric field is 5.1 mV m-1. Large values of the field-aligned current are simultaneously detected. The potential structure appears to extend to the satellite location. Using a theoretical model we have calculated the field-aligned current due to the electric field discontinuity. The magnitude of the parallel potential drop and width of the inverted-V region agree well with observation.

1424 **(INPE—2243) Ionospheric irregularities at low latitudes in the American sector.** Nakamura, Y. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Oct 1981. 126p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83704276.

A detailed analysis of the atomic oxygen airglow emission at the wavelength of 6300 A observed at Cachoeira Paulista (22°41'S, 45°00'W) shows that intensity perturbations frequently occur and propagate from north to south and from west to east. Such irregu-

larities originated in the ionospheric F region and occur essentially during the premidnight period. These perturbations have a high frequency of occurrence during spring and summer and are rare during winter and fall. The disturbances are correlated with range type spread F detected over Cachoeira Paulista, and have characteristics similar to equatorial ionospheric plasma bubbles (i.e., similar seasonal variation, time of occurrence, ionogram signatures, direction and speed of propagation, etc.). A numerical simulation is carried out for the generation and evolution of ionospheric bubbles based on the theory of the collisional Rayleigh-Taylor instability for the equatorial and Cachoeira Paulista regions. Also a study was made of the evolution of the bubble as a function of the electron density profile and as a function of the amplitude of the initial density perturbation. Assuming the electron density profile perturbed by the bubble, the [OI] 6300 A intensity was calculated for various latitudes arbitrarily taken within the photometer scarning range. The bubble was assumed to be aligned with the Earth's magnetic field and extending from higher altitudes at the equatorial region down to be arbitrary height of 150 Km at which a negligible conductivity is assumed. It was also assumed that the bubble was moving upwards with the velocity of 120 m/s, which in turn was estimated from initial numerical simulation results. The airglow calculation results show that as the bubble goes up, the disturbances in the airglow intensity propagate from north to south, in accord with observed experimental results.

1425 **(N—8325104) Terrestrial solar spectral modeling.** Bird, R.E. (Solar Energy Research Inst., Golden, CO (USA)). 1981. 12p. NTIS, PC A13/MF A01.

In Com. Photovoltaics Meas. Workshop Proc. p 171-182 (SEE N83-25093 14-44) Original document was announced as N82-15664.

The utility of accurate computer codes for calculating the solar spectral irradiance under various atmospheric conditions was recognized. New absorption and extraterrestrial spectral data are introduced. Progress is made in radiative transfer modeling outside of the solar community, especially for space and military applications. Three rigorous radiative transfer codes SOLTRAN, BRITE, and FLASH are employed. The SOLTRAN and BRITE codes are described and results from their use are presented.

1426 **(UCID—19913) Technique to extend ozonesonde temperature data to the mesopause.** Weichel, R.L. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01. Order Number DE84002749.

An analysis of global Multichannel Filter Radiometer radiances and ozone retrieval results revealed that the simulated radiances were not always representative of the measurements for the CO_2 channels sensing the temperatures in the middle and upper stratosphere. This problem was particularly pronounced, but not limited to, higher latitude winter conditions. Because of the special importance of the middle stratosphere and high latitudes for ozone analyses, a research effort was undertaken to develop an improved method (described below) of extending the temperatures from the ozonesondes used in the simulation procedure. An overview of the radiative transfer theory is provided to show the importance of the temperature profile in the calculation of simulated radiances.

1427 **(UCID—19914) Water vapor transmittance models for narrow bands in the 13 to 19 μm spectral region.** Weichel, R.L. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01. Order Number DE84002651.

The purpose of this report is to document the development of water vapor transmittance models for narrow bands (satellite sensor channels) in the 13 to 19 μm spectral region. The models are the result of research efforts of the author in 1971-1972 while on active duty with the US Air Force at the Air Force Global Weather Central (AFGWC). The models were developed for application in studies involving a temperature profiling sensor system carried aboard the satellites of the Defense Meteorological Satellite Program (DMSP), formerly DAPP. Recently, (Lovill et al., 1978; Luther et al., 1981) the models were implemented for studies concerned with methodologies to retrieve total atmospheric column ozone from measurements of newer DMSP Block 5D series satellite sensors with similar channels (see Nichols, 1975).

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 901, 925, 938, 1593, 1595, 1653

1428 **(CTA-EAV—005/81) Theoretical study of the F_2 molecule using the variational cellular method.** Lima, M.A.P.; Leite, J.R.; Fazzio, A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Atividades Espaciais). Feb 1981. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704261.

Variational Cellular Method calculations for F_2 have been carried out at several internuclear distances. The ground and excited state potential curves are presented. The overall agreement between the VCM results and ab initio calculations is fairly good.

1429 **(DESY—83-036) Monopole chemistry.** Ruijgrok, T.W.; Tjon, J.A.; Wu, T.T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1983. 11p. Available from Deutsches Elektronen-Synchrotron, Hamburg (Germany, F.R.).

Possible chemical binding of the magnetic monopole is discussed. The interaction of a monopole with a hydrogen atom is investigated in the Born-Oppenheimer approximation with the electron described by the Dirac equation. The effective potential between the monopole and the proton is determined together with the resulting bound states.

1430 **(DOE/ER/02875—T2) Systematic study of muonic atoms in the A = 100 to A = 140 nuclear mass regions (isotope and isotone shifts) and model-independent precision measurements of ground-state quadrupole moments of odd-A nuclei. Progress report No. 8, October 16, 1982-October 15, 1983.** Steffen, R.M. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics). Oct 1983. Contract AC02-76ER02875. 22p. NTIS, PC A02/MF A01. Order Number DE84001831.

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Topics covered include: precision measurements of nuclear ground-state quadrupole moments in the mass region A = 150 to A = 193; monopole and quadrupole charge parameters of deformed nuclei; quadrupole and hexadecapole moments of U and Pu nuclei; systematics of nuclear charge radii (isotope and isotone shifts) in the A = 100 to A = 140 mass region; and pionic-atom measurements. (GHT)

1431 **(DOE/ER/10668—3) Investigation of the dynamics and threshold behavior of endothermic negative ion-neutral reactions. Final report, July 15, 1980-July 14, 1983.** Tiernan, T.O.; Wu, R.L.C. (Wright State Univ., Dayton, OH (USA)). 1 Aug 1983. Contract AC02-80ER10668. 80p. NTIS, PC A05/MF A01. Order Number DE84001369.

These studies have yielded thermochemical and scattering data which are needed for understanding the ion chemistry of plasmas, and in the development of certain devices which utilize plasmas, such as MHD generators. In the course of these studies, the characteristics of various negative ion sources, including conventional electron impact, sputtering and glow discharge sources, have been extensively explored. Energy thresholds for selected collision-induced dissociation reactions involving PO^-, PO_2^-, CO_3^-, and NO_3^- have been determined, and ionic bond dissociation energies, heats of formation and electron affinities of the corresponding neutral molecules have been derived from these data. In addition, energy thresholds for endothermic electron transfer reactions involving PO^-, PO_2^-, CO_2^-, FeO_2^-, BO^-, BO_2^-, MoO^-, MoO_2^-, MoO_3^-, WO_2^- and WO_3^- have been determined, and again, these data were utilized to calculate electron affinities of the corresponding molecular species. A crossed ion-molecular beam scattering apparatus has been used to investigate the kinetics, dynamics and energy transfer characteristics of the negative ion-neutral reactions, $O^- + H_2(D_2) \rightarrow OH^-(OD^-) + H(D)$ in very low translational energy regime.

1432 **(DOE/ER/10857—2) Study of field adsorption using pulsed-laser atom-probe field-ion microscopy. Annual technical progress report, April 1, 1983-March 31, 1984.** Tsong, T.T. (Pennsylvania State Univ., University Park (USA). Dept. of Physics). 1983. Contract AC02-81ER10857. 6p. NTIS, PC A02/MF A01. Order Number DE84002280.

The high resolution pulsed-laser time-of-flight atom-probe, and the pulsed-laser imaging atom-probe are shown. The high resolution system is currently one of the most-versatile high-performance atom-probes in the world. Under good operating conditions its mass resolution can be as high as 4000, or better. It is capable of separating for example $^4He^+$ from D_2^+, $^3He^+$ from H_3^+, and $^{56}Fe^{2+}$ from N^{2+} down to 5 or 10% of the peak height. This system is also a high resolution ion energy analyzer. The resolution, E/ΔE, can be as high as 20,000 when heavy ions such as Au^+ and AuH_2^+ are analyzed. This system, like other pulsed-laser atom-probes, is also capable of analyzing low conductivity materials such as a high purity solicon of resistivity greater than 200 Ω-cm. During the past year, we have been studying formation of H_3^+ and NH_3^+. Pulsed-laser field desorption of hydrogen results in formation of H^+, H_2^+, and H_3+. The relative abundances of H^+ and H_2^+ are found to be independent of the emitter materials or surface planes. They are dependent only on the applied field. Thus these ions, though formed right at or near the surface, are not surface catalyzed reactions, though formed right at or near the surface, are not surface catalyzed reaction products. They are formed by the high applied electric field. From the field dependence of their relative abundances, and the widening ion energy distribution width of the H^+ at higher field, we conclude that H^+ is formed by field dissociation-ionization of H_2^+.

1433 **(DOE/ET/10862—3) Photoemission studies of f-electron systems: many-body effects. Progress report, October 1, 1982-October 1, 1983.** Parks, R.D. (Polytechnic Inst. of Brooklyn, NY (USA). Dept. of Physics). Oct 18893. Contract AC02-81ER10862. 4p. NTIS, PC A02/MF A01. Order Number DE84001133.

Research tasks discussed include: surface versus shakedown effects in XPS; x-ray absorption studies of rare-earth and uranium intermetallics; deep core XPS studies of the mixed valent systems Ce(Pd/sub 1-x/Ag/sub x/)$_3$ and Ce(Pd/sub 1-y/Rh/sub y/)$_3$; and photoemission experiments performed at NSLS. (GHT)

1434 **(JINR—R-4-82-810) Solution of Faddeev-type equation for two Coulomb center problem.** Belyaev, V.B.; Brener, S.E.; Galimzyanov, R.M.; Zubarev, A.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704262.

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The movement of a light particle in the field of two coulomb centers is considered. A system of equations for components of the total wave function with the appropriate asymptotic behaviour was used without using separation of variables. Effective potentials for a molecular ion of the hydrogen H_2^+ and the μ-mesic ion ddμ are calculated. In the latter system the spectrum of a mesic molecule in a state with the total angular momentum L=0 is found.

1435 **(JINR—R-4-82-889) Structure of the mesic molecular ion dTsub(μp).** Belyaev, V.B.; Gandyl', E.M.; Zubarev, A.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704263.

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dTsub(μ)-mesic molecular system in a state with total orbital momentum L=0 is considered in two-channel approximation in accordance with two channels on strong interaction dT → dT and dT → dT. Coulomb interaction Vsub(dsub(μ))+Vsub(Tsub(μ)) is taken into account by introducing the effective potential Vsub(μ) which is chosen in the form of Morse potential. The spectrum of the system is investigated as a function of effective potential parameters.

1436 **(JINR—R-14-82-826) Shadow effect in interaction of heavy ions with GaP monocrystals.** Bugrov, V.N.; Karamyan, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1982. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704265.

Portions are illegible in microfiche products1 refs.; 3 figs.; 2 tabs.; submitted to the journal Sov. Phys. - Solid State.

Parameters of the blocking minima are measured in reactions of the elastic scattering of the ^{20}Ne, ^{31}P and ^{40}Ar ions with 12, 31 and 24 MeV energy, respectively, on GaP single crystal for understanding the peculiarities of the heavy-ion interaction with single crystals. The measured angular width values psisub(1/2) for blocking minima are analysed together with the known results on the interaction of fission fragments with W and UO_2 single crystals. Deflection from the rule psisub(1/2) approximately Esup(-1/2) for the dependence of blocking minimum width from the particle energy is found. The indications to possible attenuation of orientational effects in the particle-crystal interaction with the growth of a particle mass are obtained.

1437 **(LBL—16314) Direct determination of surface structures from photoelectron diffraction.** Barton, J.J.; Bahr, C.C.; Hussain, Z.; Robey, S.W.; Klebanoff, L.E.; Shirley, D.A. (Lawrence Berkeley Lab., CA (USA)). Sep 1983. Contract AC03-76SF00098. 42p. (CONF-831171—10). NTIS, PC A03/MF A01. Order Number DE84002572.

From American Vacuum Society meeting; Boston, MA, USA (1 Nov 1983).

Photoelectron diffraction causes the intensity of photoemission peaks to vary with electron energy or exit angle. Recently, dramatic progress has been made in analyzing photoelectron diffraction data to give surface structure information. This paper summarizes our recent work with particular emphasis on the variety of information one can derive from energy-dependent photoelectron diffraction measurements.

1438 **(LBL—16545) Molecular-beam spectroscopy of interhalogen molecules.** Sherrow, S.A. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 96p. NTIS, PC E05/MF A01. Order Number DE84001286.

Thesis. Includes 1 sheet of 48x reduction microfiche.

A molecular-beam electric-resonance spectrometer employing a supersonic nozzle source has been used to obtain hyperfine spectra of $^{79}Br^{35}Cl$. Analyses of these spectra and of microwave spectra published by other authors have yielded new values for the electric dipole moment and for the nuclear quadrupole coupling constants in this molecule. The new constants are significantly different from the currently accepted values. Van der Waals clusters containing chlorine monofluoride have been studied under various expansion conditions by the molecular-beam electric-deflection method. The structural possibilities indicated by the results are discussed, and cluster geometries are proposed.

1439 **(UCRL—89447) Localized hole effects in inner-shell excitation.** Rescigno, T.N.; Orel, A.E. (Lawrence Livermore National Lab., CA (USA)). 14 Oct 1983. Contract W-7405-ENG-48. 7p. (CONF-8307103—1). NTIS, PC A02/MF A01. Order Number DE84001401.

From International symposium on wavefunctions and mechanisms from electron scattering processes; Castelgandolfo, Italy (24 Jul 1983).

Ab initio calculations of valence shell ionization potentials have shown that orbital relaxation and correlation differences usually make contributions of comparable magnitude. In marked contrast to this observation is the situation for deep core ionization, where correlation differences (~ 1 eV) play a relatively minor role compared to orbital relaxation (~ 20 eV). Theoretical calculations have shown that this relaxation is most easily described if the 1s-vacancy created by a K-shell excitation is allowed to localize on one of the atomic centers. For molecules possessing a center of inversion, this means that the molecular orbitals that best describe the final state do not transform as any irreducible representation of the molecular point group. Recent experimental work by Shaw, King, Read and Cvejanovic and by Stefani and coworkers has prompted us to carry out further calculations on N_2, as well as analogous investigations

of 1s/sub N/ → π* excitation in NO and N_2O. The generalized oscillator strengths display a striking similarity and point to the essential correctness of the localized hole picture for N_2. The theoretical calculations are briefly described, followed by a summary of the results and comparison to experiment, followed by a short discussion.

1440 **Algebraic approach to molecular rotation-vibration spectra. II. Triatomic molecules.** van Roosmalen, O.S.; Iachello, F.; Levine, R.D.; Dieperink, A.E.L. (Kernfysisch Versneller Instituut, Rijksuniversiteit Groningen, The Netherlands). *Journal of Chemical Physics;* 79: No. 6, 2515-2536(15 Sep 1983).

The algebraic approach to molecular rotation-vibration spectra introduced in a previous article is extended from di- to tri- and polyatomic molecules. The spectrum generating algebra appropriate to triatomic molecules U(4)xU(4) is explicitly constructed. Its dynamical symmetries and their relation to rigid, nonrigid, linear, and nonlinear structures are discussed. Applications to the spectra of HCN, CO_2, and H^+_3 are considered. In particular, it is shown that the algebraic description can account for the Fermi resonances occurring in CO_2. Some remarks are made on the spectrum generating algebras appropriate to polyatomic molecules.

1441 **A←X transition in Cr_2: Predissociation, isotope effects, and the 1—1 sequence band.** Riley, S.J.; Parks, E.K.; Pobo, L.G.; Wexler, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* 79: No. 6, 2577-2582(15 Sep 1983).

Two-color resonance-enhanced ionization spectroscopy with mass analysis is performed on beams of Cr_2 produced by laser vaporization and isentropic expansion cooling. For the A←X 0—0 band near 459.6 nm an extensive rotational spectrum is observed and its intensity profile is found to have a systematic modulation with J. This modulation, and its surprisingly strong dependence on isotopic composition, are interpreted in terms of a two-step predissociation of the A state and suggest a potentially important new procedure for isotope enrichment in metal systems. An additional resonant feature is found ~1 nm to the red of the origin band and is assigned to the 1—1 sequence band.

1442 **Laser-induced fluorescence of PuF_6 in the $^3\Gamma$/sub 4g/→$^1\Gamma$/sub 1g/ electronic band at room temperature.** Barefield, J.E. II; Rice, W.W.; Tiee, J.J.; Walters, R.T. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 79: No. 6, 2621-2625(15 Sep 1983).

When PuF_6 is photoexcited at 797.3 nm, fluorescence is observed from the 1 μm electronic energy level. The lifetime tau of the fluorescence signal varies with pressure. The lifetimes cover a range of 655 to 243 ns for a pressure range of 0.5 to 72 Torr. A linear Stern—Volmer relationship was obtained over the complete pressure range considered. An extrapolation to zero pressure yields an intercept of τ_0 = 663 ns and a slope of 3.62 x 10^4 $Torr^{-1}$ s^{-1}. Fluorescence and excitation spectra are reported and are in good agreement with the previously reported absorption spectrum of PuF_6.

1443 **Total scattering cross sections for the helium—argon system at low relative velocities.** York, R.W.; Taylor, W.L.; Pickett, P.T. (Monsanto Research Corporation-Mound, Miamisburg, Ohio 45342). *Journal of Chemical Physics;* 79: No. 6, 2831-2838(15 Sep 1983).

Absolute total cross sections for He—Ar were measured in the relative velocity range of ~800—2000 m/s by passing a supersonic nozzle beam through a cell containing the target gas. The beam attenuation was determined by passing the unscattered beam particles into a quadrupole detector. The absolute number density of target gas particles in the target cell was obtained by a calibrated-flow method of introducing gas into the cell during an experiment. A correction was applied for the angular resolution of the apparatus. The average experimental uncertainty was estimated to be ~3% to 3.5%. The present results, as well as other available data, were deconvoluted in a two-step process to yield Q/sup I/ and Q/sup II/, the first and second approximations to the total cross section, as a function of the relative velocity. The composite results of all experimental data were compared to seven interatomic potentials and the Hartree—Fock-dispersion (HFD) potential represented the data best.

1444 **Theory of spontaneous-emission line shape in an ideal cavity.** Sanchez-Mondragon, J.J.; Narozhny, N.B.; Eberly, J.H. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* 51: No. 7, 550-553(15 Aug 1983).

The spontaneous-emission spectrum of an atom in an ideal cavity is calculated.

1445 **Effect of extrinsic electric fields upon dielectronic recombination: Mg^{1+}.** LaGattuta, K.; Hahn, Y. (Physics Department, University of Connecticut, Storrs, Connecticut 06268). *Physical Review Letters;* 51: No. 7, 558-561(15 Aug 1983).

Recently, large discrepancies have appeared between theoretical predictions and experimental measurements of dielectronic recombination cross sections (σ/sup DR/) for Mg^{1+} targets. This disagreement has provoked new work aimed at understanding, more fully, the effect of applied fields upon the dielectronic recombination process. This Letter reports calculations of σ/sup DR/ for Mg^{1+} in a small applied electric field. The field effect is large enough to bring the experimental σ/sup DR/ into much closer agreement with the theory.

1446 **Inverted cusps in electron spectra near zero velocity in an attractive Coulomb field.** Burgdoerfer, J. (University of Tennessee, Knoxville, Tennessee 37996 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review Letters;* 51: No. 5, 374-377(1 Aug 1983). Contract W-7405-ENG-26.

An inverted cusp in the near-zero-velocity electron-loss spectrum for a 2p (m = 0) initial state is predicted for an attractive final-state Coulomb interaction. The dip occurs in the singly differential cross section dσ/dv/sub e/, calculated in Born approximation, at v/sub e/ = v/sub P/, where the electron velocity v/sub e/ matches the projectile velocity v/sub P/ and where the familiar cusp normally appears. The dip becomes more pronounced with increasing projectile velocities v/sub P/→∞. Its existence is traced to the odd Pi/sub z/ parity of the initial state.

1447 **Optical Stark effects on pure-spin Raman transitions in molecular oxygen.** Owyoung, A.; Hill, R.A.; Esherick, P. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* 8: No. 8, 425-427(Aug 1983).

Fully resolved pure-spin Raman transitions near 2 cm^{-1} have been observed in $^3\Sigma$/sub g/ ground-state molecular oxygen using stimulated Raman techniques. Anomalous differences between polarized and depolarized spectra are fully explained in terms of optical Stark effects.

1448 **Absorption in the ν_3 band of UF_6 dissolved in solid xenon.** Holland, R.F.; Maier, W.B. II. (University of California, Los Alamos National Laboratory, Chemistry Division, Los Alamos, New Mexico 87545). *Spectroscopy Letters;* 16: No. 6, 409-449(Jun 1983).

The ν_3 band of UF_6 isolated in solid xenon is shown to consist of a single sharp spectral feature.

1449 **Ion time-of-flight spectroscopy: Krypton charge state spectra as a function of photon excitation energy near the K edge.** Hastings, J.B. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source); Kostroun, V.O. (Cornell Univ., Ithaca, NY (USA). Nuclear Science and Engineering Program; Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). *Nuclear Instruments and Methods in Physics Research;* 208: No. 1-3, 815-818(15 Apr 1983). (CONF-820839—).

From International conference on X-ray and VUV synchrotron radiation instrumentation; Hamburg, F.R. Germany (9 Aug 1982).

Also published as report BNL--31970; 1982.

In this experiment, we have recorded the charge state distribution resulting from atomic rearrangement following the creation

of the inner shell vacancies in krypton atoms. Intense, highly collimated, monochromatic and tunable X-ray radiation available at the CHESS synchrotron radiation facility at Cornell was used to photionize krypton atoms in a gas jet target, and a time-of-flight spectrometer was used to record the ions in different charge states formed after photoionization. Charge state spectra were recorded below, at the 'peak' in the K edge and above the edge. Below the edge, charge states +4 to +7 were observed with appreciable intensity, while at, and above the edge, the charge states ranged from +4 to +10.

1450 **Theoretical analysis of the quantum contributions to the reactions $H_2(v=1)+H \rightarrow H + H_2(v'=0,1)$ and $H_2(v=1) + D \rightarrow H + HD(v'=0,1)$.** Walker, R.B. (Los Alamos National Lab, NM); Hayes, E.F. *Journal of Physical Chemistry;* 87: No. 7, 1255-1263(31 Mar 1983).

Detailed quantum-dynamical calculations on the Siegbahn-Liu-Truhlar-Horowitz (SLTH) surface reported for a rotating linear model (RLM) approximation with and without corrections for bending zero-point energy. These dynamical results predict that there are substantial prethreshold quantum contributions to state-selected cross sections and rate constants for both of the title reactions. However, the mechanisms for these prethreshold quantum effects are not the same. For $H_2(v=1)+H$, a threshold resonance is responsible for the large prethreshold quantum contribution: 65% of the total rate of 300K. For $H_2(v=1)+D$, tunneling is found to be large, leading to a 66% prethreshold quantum contribution at 300K. These large quantum corrections are not large enough to provide an explanation for the previously identified discrepancy between the experimental and classical theoretical rate constants for these reactions.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 203, 1643

1451 **(DOE/MC/16412—1444) Review of fluid dynamics of multi-phase fluid flow. Final report - Task 5.** (Resource Technologies Group, Inc., Morgantown, WV (USA)). 20 Aug 1982. Contract AC21-81MC16412. 110p. NTIS, PC A06/MF A01. Order Number DE83016105.

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In the United States there is considerable research activity related to the fluid dynamics of multi-phase fluid flow in pipes. This report has been developed primarily as a reference against which DOE may characterize new activity in order to prevent duplication, identify complementary work, etc. As such, the report is a state of activity review which summarizes in tabular form the activity topics and the available administrative identifiers. For each project, a brief description of work, goals and results is given in the appendix. In order to provide a useful document within budgetry limits, research in the areas of fluidized-bed technology and flow stream compositional changes as a result of chemical reactions were excluded; the former was excluded as a field which is generally separate from pipe flow and in which Morgantown Energy Technology Center (METC) already has substantial knowledge and expertise. The chemical effects were similarly excluded. The search procedure began with two independent computerized literature searches, using on-line materials available to DOE and outside consultants. Results of these searches were combined with a limited amount of other materials provided by the METC and Pittsburgh Energy Technology Center (PETC), to provide a starting data base. Supplementary information was then obtained through manual searches of the recent literature and through individual investigators. 2 tables.

1452 **(LA—9861-M) MIXPAC: a subroutine package for calculating equations of state for equilibrium mixtures of materials.** Cranfill, C.W. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01. Order Number DE84002302.

This manual describes MIXPAC, a subroutine package for calculating equations of state (i.e., thermodynamic and transport properties) for plasmas composed of equilibrium mixtures of materials. The package is vectorized for the Los Alamos Cray-1 computers and uses EOSPAC, another vectorized subroutine package, to access the Los Alamos Sesame EOS data library. Each mixture is forced to be in equilibrium through the constraints that all its constituents have the same values for two state functions (e.g., temperature and pressure). The desired equations of state (including first partial derivatives) are then calculated for the mixture consistent with these constraints. All equations of state available for pure materials through EOSPAC are available for equilibrium mixtures through MIXPAC.

1453 **(N—8322542) Analogy between fluid cavitation and fracture mechanics.** Hendricks, R.C.; Mullen, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1983. 26p. (CONF-830301—21; NASA-TM—83071; E—1519). NTIS, PC A03/MF A01.

From ASME-JSME thermal engineering joint conference; Honolulu, HI, USA (20 Mar 1983).

When the stresses imposed on a fluid are sufficiently large, rupture or cavitation can occur. Such conditions can exist in many two-phase flow applications, such as the choked flows, which can occur in seals and bearings. Nonspherical bubbles with large aspect ratios have been observed in fluids under rapid acceleration and high shear fields. These bubbles are geometrically similar to fracture surface patterns (Griffith crack model) existing in solids. Analogies between crack growth in solid and fluid cavitation are proposed and supported by analysis and observation (photographs). Healing phenomena (void condensation), well accepted in fluid mechanics, have been observed in some polymers and hypothesized in solid mechanics. By drawing on the strengths of the theories of solid mechanics and cavitation, a more complete unified theory can be developed.

1454 **(N—8324338) Reconnection rates, small scale structures and simulations.** Matthaeus, W.H. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1983. 11p. (NASA-TM—85177). NTIS, PC A02/MF A01.

Presented at the Solar Terrest. Phys. Workshop.

The study of reconnection in the context of one fluid, two dimensional magnetohydrodynamics (MHD), with spatially uniform constant density, viscosity and resistivity is thought to retain most of the physics important in reconnection. Much of the existing reconnection literature makes use of this approach. This discussion focuses on attempts to determine the properties of reconnection solutions to MHD as precisely as possible without regard to the intrinsic limitations of the model.

1455 **(N—8324339) Viscous, resistive MHD stability computed by spectral techniques.** Dahlburg, R.B.; Zang, T.A.; Montgomery, D.; Hussaini, M.Y. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1983. 30p. (NASA-TM—85318). NTIS, PC A03/MF A01.

Expansions in Chebyshev polynomials are used to study the linear stability of one dimensional magnetohydrodynamic (MHD) quasi-equilibria, in the presence of finite resistivity and viscosity. The method is modeled on the one used by Orszag in accurate computation of solutions of the Orr-Sommerfeld equation. Two Reynolds like numbers involving Alfven speeds, length scales, kinematic viscosity, and magnetic diffusivity govern the stability boundaries, which are determined by the geometric mean of the two Reynolds like numbers. Marginal stability curves, growth rates versus Reynolds like numbers, and growth rates versus parallel wave numbers are exhibited. A numerical result which appears general is that instability was found to be associated with inflection points in the current profile, though no general analytical proof has emerged. It is possible that nonlinear subcritical three dimensional instabilities may exist, similar to those in Poiseuille and Couette flow.

1456 **(N—8324340) Dynamic alignment and selective decay in MHD.** Matthaeus, W.H.; Montgomery, D. (College of William and Mary, Williamsburg, VA (USA)). 1983. 14p. (NASA-CR—170259). NTIS, PC A02/MF A01.

Under some circumstances, incompressible magnetohydrodynamic turbulence will evolve toward a state in which the velocity fields and magnetic fields are aligned or anti-aligned. We propose a mechanism for this effect and illustrate with numerical computations. Under some other circumstances, the energy appears to decay selectively toward a minimum energy state in which the kinetic energy has disappeared. It has not been possible so far to identify a boundary in the phase space which divides the two regimes.

1457 **(N—8327809) Rate processes in gas phase.** Hansen, C.F. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). May 1983. 263p. (NASA-RP—1090; A—8817). NTIS, PC A12/MF A01.

Reaction-rate theory and experiment are given a critical review from the engineers' point of view. Rates of heavy-particle, collision-induced reaction in gas phase are formulated in terms of the cross sections and activation energies of the reaction. The effect of cross section function shape and of excited state contributions to the reaction both cause the slope of Arrhenius plots to differ from the true activation energy, except at low temperature. The master equations for chemically reacting gases are introduced, and dissociation and ionization reactions are shown to proceed primarily from excited states about kT from the dissociation or ionization limit. Collision-induced vibration, vibration-rotation, and pure rotation transitions are treated, including three-dimensional effects and conservation of energy, which have usually been ignored. The quantum theory of transitions at potential surface crossing is derived, and results are found to be in fair agreement with experiment in spite of some questionable approximations involved.

1458 **Density profile of a fluid bounded by a soft wall.** Percus, J.K.; Williams, G.O. (Courant Institute of Mathematical Sciences and Physics Department, New York University, New York, New York 10012). *Journal of Chemical Physics;* 79: No. 6, 3009-3017(15 Sep 1983).

An approximate relationship is developed between the density profile of a simple classical fluid bounded by a soft wall and that bounded by an idealized hard wall. This relationship is exact for a class of one-dimensional fluids, and also constitutes a simplification of the "shielding approximation." It accurately reproduces several Monte Carlo calculations.

6450 High Energy Physics

1459 **(DOE/ER/40025—67) Elementary particles and high-energy physics. Progress report, January 1982-December 1982.** Ford, W. (Colorado Univ., Boulder (USA). Dept. of Physics). Oct 1983. Contract AC02-81ER40025. 24p. NTIS, PC A02/MF A01. Order Number DE84001691.

The MAC group presented measurements of the lifetime and the fragmentation function of b quarks. They have also made improved measurements of the electroweak asymmetry in the reaction $e^+e^- \rightarrow \mu^+\mu^-$ at 29 GeV and have carried out several QED tests as well. The Broadband Photon Beam collaboration (E-401) has completed and published its analysis of psi and psi' photoproduction on hydrogen and deuterium. Design work continues on E-687, the Tevatron photoproduction experiment. The Tagged Photon Spectrometer has reported its first results: inelastic psi photoproduction and a study of charm decay $D^0 \rightarrow K^-\pi^+\pi^0$. Colorado is also carrying out studies of inclusive hadron production and jet physics in photoproduction. The theoretical group has carried out studies of novel forms of supersymmetric grand unification models. A calculation of dynamical symmetry breaking without fundamental scalars was completed and applied to various models of the electroweak interactions. Hadronic phenomenology calculations included computations of total cross sections using a model of the pomeron and studies of polarization asymmetry in inclusive baryon production. Lattice calculations included the discovery that dynamical fermions destroy the confinement-deconfinement transition in finite-temperature gauge theory. Studies of stochastic methods for hamiltonian gauge theories were performed.

1460 **Intense medium-energy sources of strangeness (UC - Santa Cruz, 1983).** Goldman, T.; Haber, H.E.; Sadrozinski, H.F.W. (eds.). New York, NY; American Institute of Physics (1983). 253p. (CONF-830339—). American Institute of Physics, 335 East 45th St., New York, NY 10017. Contract W-7405-ENG-36.

From Theoretical symposium on intense medium energy sources of strangeness; Santa Cruz, CA, USA (19 Mar 1983).

Separate abstracts were parepared for the papers presented. (WHK)

6451 Particle Interactions And Properties - Experimental

1461 **(BNL—33793) Trends in exotic-atom research.** Lambrecht, R.M.; Horvath, D. (Brookhaven National Lab., Upton, NY (USA); British Columbia Univ., Vancouver (Canada). TRIUMF Facility). 1983. Contract AC02-76CH00016. 10p. (CONF-830455—9). NTIS, PC A02/MF A01. Order Number DE84001679.

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

An attempt was made to analyze the trends in the development of exotic-atom research on the basis of a recently compiled bibliography. The analysis of nearly 4000 publications demonstrated that: (1) exotic atoms are nuclear probes used in every field of physics, from the test of quantum electrodynamics (QED) to chemical physics, to materials sciences; (2) the role of nuclear and atomic physics in exotic atom research is decreasing (although it is still significant), while that of materials sciences and chemial physics is exponentially increasing; and (3) prior to 1980 most investigators were mainly interested in atoms with negative muons, while during the last few years the positive muon (μSR) studies have dominated exotic atom research.

1462 **(BONN-HE—83-4) Recent results on prompt photon production at the CERN ISR.** Burkert, V. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Mar 1983. 13p. (CONF-830140—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751313.

From 18. Rencontre de Moriond conference; La Plagne, France (23 Jan 1983).

Recent results in the study of high psub(T) prompt photons in pp collisions from the experiments R806/807 are reviewed. A study of correlations of charged particles associated with high psub(T) prompt photons, the $\sqrt{s}$ - dependence of the inclusive cross section and a first measurement of the γ/π^0 ratio at small angles are presented.

1463 **(CERN—83-02(Vol.2)) Workshop on SPS fixed-target physics in the years 1984-1989. Vol. 2. Proceedings.** Mannelli, I. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Feb 1983. 531p. NTIS (US Sales Only), PC A23/MF A01. Order Number DE84780034.

The papers presented were entered into the data base separately. (WHK)

1464 **(DESY—83-035) Measurement of the processes $e^+e^- \rightarrow e^+e^-$ and $e^+e^- \rightarrow \gamma\gamma$ at PETRA.** Dietrich, G.; Elsen, E.; Heinzelmann, G.; Kado, H.; Meier, K.; Petersen, A.; Schneekloth, U.; Weber, G.; Bethke, S.; Dieckmann, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751334.

Cross sections for the reactions $e^+e^- \rightarrow e^+e^-$ (Bhabha scattering) and $e^+e^- \rightarrow \gamma\gamma$ are measured for center-of-mass (c.m.) energies $\sqrt{s}$ between 12.0 and 34.6 GeV. The results agree with the predictions of Quantum Electrodynamics (QED) and the cut-off parameters are determined. From Bhabha scattering at the highest energy, $\langle\sqrt{s}\rangle$ = 34.6 GeV, the 1sigma limits $0.12 < \sin^2\text{thetasub(w)} < 0.38$ are obtained for the weak mixing angle. The higher order (α^3) QED processes $e^+e^- \rightarrow e^+e^-\gamma$ and $e^+e^- \rightarrow \gamma\gamma\gamma$ are also studied and are found to agree with the α^3 QED predictions. A search for excited electrons is carried out by investi-

gating the (esup(=)$\gamma\gamma$) invariant mass distribution in the reaction $e^+e^- \rightarrow e^+e^-\gamma$.

1465 **(DOE/ER/01195—488) Exclusive diffractive dissociation of K/sub L/ mesons at high energies.** Lamm, M.J. (Illinois Univ., Urbana (USA). Dept. of Physics). 1983. Contract AC02-76ER01195. 149p. (COO—1195-488). NTIS, PC A07/MF A01. Order Number DE84001568.

Portions are illegible in microfiche products; Thesis.

Using the hadronic component of the Fermilab broad band neutral beam, we have observed diffractive dissociation of K/sub L/ mesons with a carbon target into the exclusive final states Ks $\pi^+\pi^-$, K*(890)$^{+-}\pi^{-+}$, Ks rho^0, Ks ω^0, and Ks phi, but not Ks psi. The diffractive production cross section for these states is not strongly dependent on incident energy varying at most by 30% between 75 and 150 GeV. The shapes of the mass distributions do not change appreciably as a function of lab energy. The ratio of the diffractive mass threshold production of K*(890)$^{+-}\pi^{-+}$, Ks rho^0, Ks ω^0 and Ks phi is compared with results of two other experiments at lower lab energies with charged kaon beams on a hydrogen target.

1466 **(DOE/ER/03992—534) Consistency of two recent experiments on Σp $\rightarrow$ne nu.** Bohm, A.; Kielanowski, P.; Garcia, A. (Texas Univ., Austin (USA). Center for Particle Theory; Instituto Politecnico Nacional, Mexico City. Centro de Investigacion y de Estudios Avanzados). Sep 1983. Contract AS05-76ER03992. 8p. NTIS, PC A02/MF A01. Order Number DE84001517.

It is shown that the WA2 experiment measuring the electron energy spectrum in $\Sigma^- \rightarrow$ ne nu and the Argonne-Chicago-Ohio State experiment measuring the electron asymmetry in $\Sigma^- \rightarrow$ ne nu are consistent with each other, if large pseudotensor formfactors are present.

1467 **(DOE/ER/04449—44) Study of the neutron-proton interaction in the 300 to 700 MeV energy region. Annual progress report, 1982-1983.** Northcliffe, L.C. (Texas A and M Univ., College Station (USA). Research Foundation). 1983. Contract AS05-76ER04449. 22p. NTIS, PC A02/MF A01. Order Number DE84001453.

Progress by the LAMPF user group from Texas A and M University is described. The principal activities since last year's report have included four months of data taking to complete LAMPF Experiment No. 518 (Polarized Beam and Target Experiments in the p-p System. Phase II. Measurements of A/sub zz/ and A/sub xz/ for the d/sub π^+ Channel and for the Elastic Channel from 500 to 800 MeV) which began running in mid-June 1982. There were also about six weeks of data taking on LAMPF Experiment No. 664 (The Measurement of the Polarization Transfer Coefficients A/sub t/' and D/sub t/ at 500, 650 and 800 MeV for the Reaction d(polarized p, polarized n)2p), and one week of data taking at 800 MeV on LAMPF Experiment No. 590 (Measurement of D(θ) in p-n and n-p Scattering at 800, 650 MeV and Other Energies with Associated p-p Measurements). In addition there were preparations for LAMPF Experiment No. 665 (The Measurement of np Elastic Scattering Spin Correlation Parameters with L- and S-Type Polarized Beam and Target between 500 and 800 MeV) which began running last month and will continue until the end of the year. (WHK)

1468 **(DOE/ER/40033—52) Experimental studies of elementary-particle interactions at high energies. Technical progress report.** (Rockefeller Univ., New York (USA)). 3 Oct 1983. Contract AC02-81ER40033. 25p. NTIS, PC A02/MF A01. Order Number DE84001259.

The high-energy physics program at Rockefeller University is reviewed. Work at CERN is described including I.S.R. experiment R-110 and S.P.S.C. experiment UA-6. The research program at FNAL primarily involves analysis of the data of the inclusive photon dissociation experiment, E-612. The neutrino mass experiment at Livermore Laboratory is briefly described. Related Rockefeller University reports are listed. (WHK)

1469 **(LBL—16596) Problems and prospects in strange baryon spectroscopy.** Tripp, R.D. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 8p. (CONF-830798—4). NTIS, PC A02/MF A01. Order Number DE83018119.

From 3. LAMPF II workshop; Los Alamos, NM, USA (18 Jul 1983).

The study of Y* resonances by means of formation experiments has long suffered from deficiences of available K^- beams, both in intensity and purity. For example a typical single-stage separated K^- beam of 750 MeV/c has at BNL or CERN an intensity of about 10^5 K^-/pulse with a ratio of K^- to contaminating π^-, μ^-, and e^- of 1:10. At a kaon factory the K^- yield is expected to be several orders of magnitude higher. Then, trading intensity for purity by employing two stages of separation and/or improved beam optics, one could reasonably expect to obtain an intensity of 10^6 K^-/sec, unencumbered by the high contamination that would otherwise torture the apparatus. Detector requirements are briefly considered.

1470 **(MPI-PAE/Exp.El.—119) Total energy trigger at large angles used in a calorimetric study of 150 GeV and 300 GeV pion and proton interactions on hydrogen.** Marzo, C. de; Palma, M. de; Distante, A.; Favuzzi, C.; Lavopa, P.; Maggi, G.; Posa, F.; Ranieri, A.; Selvaggi, G.; Spinelli, P. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Jun 1983. 29p. Available from Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.).

Hard hadronic scattering was studied by selecting 150 GeV and 300 GeV π^-p and pp events with large energy in a 240 cell calorimeter covering 45° to 135° in the c.m.s. polar angle and the full 2π azimuth. A downstream calorimeter measured the remaining energy flow at smaller angles. For large energy deposited in the segmented calorimeter the proton induced cross section drops below the pion induced cross section, as expected in a constituent scattering picture. However, neither a simple energy scaling of the cross section nor a dominant jet structure of the events is observed. No evidence was found for recently proposed higher-twist mechanisms leading to events with no forward spectator jet or with a large-psub(T) single particle in the final state. However, the observed cross sections in the relevant kinematic regions are considerably larger than predicted by the higher-twist models.

1471 **(SLAC-PUB—3232) Results from the Crystal Ball at DORIS II.** Gaiser, J.E. (Stanford Linear Accelerator Center, CA (USA)). Oct 1983. Contract AC03-76SF00515. 12p. NTIS, PC A02/MF A01. Order Number DE84002745.

Results are presented from studies of the inclusive photon spectra in hadronic decays of the Υ' and Υ and the exclusive channel $\Upsilon' \rightarrow \gamma\gamma\Upsilon \rightarrow \alpha\alpha l^+l^-$, by the Crystal Ball detector at DORIS II. We measure two signals in the $\Upsilon' \rightarrow \gamma$ + anything inclusive channel at $E(\gamma) = 108.3 \pm 0.9 \pm 3.0$ MeV and at $E(\gamma) = 127.5 \pm 1.2 \pm 4.0$ MeV. Branching ratios obtained for these signals are: $BR[\Upsilon' \rightarrow \gamma(108) + \text{anything}] = (6.3 \pm 1.3 \pm 1.4)\%$ $BR[\Upsilon' \rightarrow \gamma(128) + \text{anything}] = (6.0 \pm 1.3 \pm 1.4)\%$.

1472 **Comparison of the deep-inelastic structure functions of deuterium and aluminum nuclei.** Bodek, A.; Giokaris, N.; Atwood, W.B.; Coward, D.H.; Dubin, D.L.; Breidenbach, M.; Elias, J.E.; Friedman, J.I.; Kendall, H.W.; Poucher, J.S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **51**: No. 7, 534-537(15 Aug 1983). Contract AC02-76ER13065;AC03-76SF00515.

The deep-inelastic electromagnetic structure functions of deuterium and aluminum nuclei have been measured. The kinematic dependence of the ratio of aluminum and deuterium structure functions is similar to the dependence of the ratio of steel and deuterium structure functions, and provides further evidence for the distortion of the quark momentum distributions of nucleons bound in a nucleus.

1473 **Measurement of the rate of increase of neutrino cross sections with energy.** Blair, R.; Barish, B.; Chu, Y.K.; Jin, B.; McFarlane, D.; Messner, R.L.; Lee, J.; Ludwig, J.; Novikoff, D.B.; Purohit, M.V. (California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* 51: No. 5, 343-346(1 Aug 1983).

The energy dependence of the cross section for neutrino- and antineutrino-nucleon charged current interactions has been determined from data taken in Fermilab's dichromatic neutrino beam. $\sigma/\sup \nu//E = (0.669 +- 0.003 +- 0.024) \times 10^{-38}$ cm²/GeV and $\sigma/\sup$ nu-bar//E = (0.340 +- 0.003 +- 0.02) x 10^{-38} cm²/GeV are found. These results are higher than some previous measurements.

1474 **D^0 spectrum from B-meson decay.** Green, J.; Hicks, R.C.; Sannes, F.; Skubic, P.; Snyder, A.; Stone, R.; Chen, A.; Goldberg, M.; Horwitz, N.; Jawahery, A. (Rutgers University, New Brunswick, New Jersey 08854). *Physical Review Letters;* 51: No. 5, 347-350(1 Aug 1983).

The inclusive branching fraction for B-meson decay into D^0 mesons and the momentum spectrum of the D^0's have been measured. 0.8 +- 0.2 +- 0.2 D^0 per B decay was found. The shape of the spectrum suggests an interesting picture of B-meson decay.

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REFER ALSO TO CITATION(S) 1499, 1506, 1513

1475 **(CBPF-MO—002/81) Helicity formalism and its applications.** Otter, G.; Endler, A.M.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Dec 1981. 145p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83704279.

The helicity formalism is exhaustively studied and applications in reaction and decay problems are made.

1476 (CERN—83-02(Vol.2), pp 371-383) **Polarization asymmetries and gauge theory interactions at short distances.** Craigie, N.S. (International Centre for Theoretical Physics, Trieste (Italy); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 8 figs.

In this talk, we give the arguments as to why spin asymmetries test fundamental properties of the underlying gauge theories of elementary particles, concentrating mainly on electro-weak and QCD interactions, but also looking at the future and possible signatures for supersymmetric strong interactions. We also mention briefly the role helicity asymmetry measurements can play as regards higher order corrections, including higher twist, in QCD.

1477 (CERN—83-02(Vol.2), pp 13-22) **Lepton nucleon scattering.** Gaemers, K.J.F. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands); Amsterdam Univ. (Netherlands). Inst. voor Theoretische Fysica). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 5 figs.

The author discusses the theoretical reasons for the study of deep inelastic scattering. In this connection he considers structure functions, hadronic final states, the production of new flavous, and weak interaction effects.

1478 (CERN—83-02(Vol.2), pp 23-29) **Spin structure at the partonic level. Pt. 1. Deep inelastic lepton scattering.** Leader, E. (Westfield Coll., London (UK)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

The fundamental internal structure of hadrons can only be probed fully using polarised beams and targets. We describe some of the essential features that can be studied in electromagnetic and weak charged current reactions and make some comments about Drell-Yan processes.

1479 (CERN—83-02(Vol.2), pp 30-54) **Weak interactions with muon beams.** Benvenuti, A.C. (Istituto Nazionale di Fisica Nucleare, Bologna (Italy)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 31 refs. and 11 figs.

The feasibility of studying weak interactions with muon beams at the CERN SPS has been investigated. The measurements of cross-section asymmetries induced by the interference of the one photon and Z^0 propagators were found to be the best suited for the SPS energy domain. The utilization of the large luminosity BCDMS spectrometer could provide sin²thetasub(w) measurements with an error of +- 0.01 and an accurate determination of the muon couplings to the Z^0.

1480 (CERN—83-02(Vol.2), pp 83-96) **Study of beauty and charm muoproduction at the SPS.** Clifft, R.W. (Science Research Council, Chilton (UK). Rutherford and Appleton Labs.); Goessling, C. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Sloan, T.; Wimpenny, S.J. 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 1 tab. and 3 figs.

We propose an experiment to study beauty and charm muoproduction via semi-leptonic decays into multi-muon final states. The apparatus for the experiment is based on the EMC Forward Spectrometer (NA2) with a factor proportional 500 increase in luminosity. The measurements proposed include the study of upsilon and B-anti B production and will provide for a much improved experimental limit on the amount of D^0 - anti D^0 mixing. From a comparison of the charm decays into 2 and 3-muon final states it is proposed to make a direct measurement of the intrinsic charm content of the nucleon. We also comment on possible studies of rare charm and beauty decays into multi-muon final states.

1481 (CERN—83-02(Vol.2), pp 180-189) **Theoretical issues in neutrino physics.** Smith, C.H.L. (Oxford Univ. (UK). Dept. of Theoretical Physics). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 37 refs.

A brief review is presented of some issues which might be addressed by future neutrino experiments at the SPS.

1482 (CERN—83-02(Vol.2), pp 272-279) **Weak decays of heavy flavors.** Fritzsch, H. (Muenchen Univ. (Germany, F.R.). Sektion Physik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

The purpose of this talk is to summarize the main features and problems of heavy flavor decays to be studied in the future.

1483 (CERN—83-02(Vol.2), pp 315-337) **Dileptons.** Freudenreich, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 13 figs. and 3 tabs.

First a review of the present status of theory and experiment as discussed at the workshop is given. The need for data from intense π^+ beams is stressed and a possible subtraction procedure of the proton background in the π^+ data is described. The interest in

more anti p and p induced data is presented together with a comparison of the competition from different accelerators. Finally new projects for the measurement of photons produced in association with lepton pairs are discussed.

1484 (CERN—83-02(Vol.2), pp 338-352) **Glueballs: Present and future.** Zitoun, R. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 62 refs. and 7 figs.

This talk reviews the predicted properties of the glueballs. The glueball candidates are presented and a review of experiments looking for glueballs is given.

1485 (CERN—83-02(Vol.2), pp 353-370) **Hadron and photon spin physics at the SPS: Its interest, feasibility and context.** Rossum, L. van (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 7 figs. and 2 tabs.

The author discusses the theoretical reasons for the study of polarization phenomena at the CERN SPS.

1486 (CERN—83-02(Vol.2), pp 384-391) **Spin structure at the partonic level. Pt. 2. . QCD tests in hadronic reactions.** Leader, E. (Westfield Coll., London (UK)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With many figs.

Knowledge of the spin and momentum distribution of partons inside a polarised nucleon, as deduced from lepton scattering, is combined with lowest order QCD to calculate spin dependent parameters in large psub(T) hadronic reactions. Clear predictions emerge in some cases and are in conflict with present experimental results. There is a real challenge to improve both theory and experiment.

1487 **(DESY—83-022) Monopole catalysis of proton decay.** Weisz, P.; Walsh, T.F.; Tsun Wu, T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751335.

The Rubakov effect (monopole catalysis of proton decay at strong-interaction cross sections) is absent for SU(5) grand-unified monopoles, because of non-existence of a zero-energy fermion-monopole bound state in this theory.

1488 **(DESY—83-033) Scalar electron production in e^+e^- annihilation.** Kuroda, M.; Kobayashi, T.; Yamada, S.; Ishikawa, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751336.

The single scalar electron production process e^+e^- -> esup(+-) + Photino + scalar electron (scalar electron -> esup(-+) + Photino), with the detection of e^+ as well as e^-, provides a clean method to detect scalar electrons when their masses are not lighter than the beam energy. We made a complete calculation of the process and evaluated the production cross sections.

1489 **(DESY—83-041) Kazama-Yang monopole-fermion bound states. Pt. 1.** Olaussen, K.; Olsen, H.A.; Oeverboe, I.; Osland, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1983. 31p. Available from Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

We present explicit, approximate, remarkably precise results for the Kazama-Yang monopole-fermion binding energies and wave functions. The results are valid for the states of lowest angular momentum and for the binding energy M - E << M. They agree very well with the numerically calculated values.

1490 **(DOE/ER/10663—2) Theory and phenomenology of strong- and weak-interaction high-energy physics.** (Arizona Univ., Tucson (USA). Dept. of Physics). [nd]. Contract AC02-80ER10663. 7p. NTIS, PC A02/MF A01. Order Number DE84001765.

Research efforts center around the quark model as it pertains to low energy strong, electromagnetic, and weak interactions: (1) nonperturbative QCD, (2) perturbative QCD, (3) scalar mesons, (4) quark wave functions, (5) particle mixing, and (6) weak quark decays. Also, nonperturbative properties of classical and quantum field theories are under study. Research is briefly described. (WHK)

1491 **(DOE/ER/40048—16) Soliton bag: dynamics and the quark plasma.** Wilets, L.; Goldflam, R.; Achtzehnter, J.; Bickeboller, M.; Dethier, J.L.; Henley, E.M.; Lubeck, G.; Rehr, J.; Schuh, A. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). Jun 1983. Contract AC06-81ER40048. 6p. (CONF-830674—5). NTIS, PC A02/MF A01. Order Number DE84001103.

From 6. international Balaton topical conference on high energy nuclear physics; Balatonfured, Hungary (6 Jun 1983).

The soliton model of interacting quarks and gluons, introduced by Friedberg and Lee, effects both spatial and color confinement of the constituents. The properties of the static bag have been reported previously. Because the model is described by a complete Hamiltonian, the dynamics of the system can be followed unambiguously. For this purpose, we employ theoretical methods which have proved effective in the study of nuclear collective motion, heavy ion collisions, and fission. We consider three levels of approximation to bag dynamics: First, the normal modes of excitation of the quarks and of the soliton field are considered. At the second level of approximation, the interaction between quark and soliton modes is calculated for small amplitude oscillations. At the third level, large scale deformations such as bag collisions, e.g. N-N scattering is studied. (WHK)

1492 **(DOE/ER/40048—17) Soliton bag model.** Goldflam, R.; Wilets, L. (Washington Univ., Seattle (USA). Dept. of Physics). Jul 1983. Contract AC06-81ER40048. 12p. (CONF-830798—5). NTIS, PC A02/MF A01. Order Number DE84001173.

From 3. LAMPF II workshop; Los Alamos, NM, USA (18 Jul 1983).

The soliton bag model of Friedberg and Lee is motivated as a model of long range behavior of QCD. Some numerical results for the nucleon are presented. The question of Lorentz covariance and future trends in bag model physics are explored.

1493 **(IFT-M—01/81) Symmetry breaking and restoration in gauge theories.** Natale, A.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). [nd]. 128p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE83704249.

A review is made of the utilization of the Higgs mechanism in spontaneous symmetry breaking. It is shown that such as ideas came from an analogy with the superconductivity phenomenological theory based on a Ginzburg-Landau lagrangian. The symmetry restoration through the temperature influence is studied.

1494 **(SLAC-PUB—3181) Factorisation of long distance contributions to the Drell-Yan cross section.** Sachrajda, C.T. (Stanford Linear Accelerator Center, CA (USA); Southampton Univ. (UK). Dept. of Physics). Aug 1983. Contract AC03-76SF00515. 18p. (CONF-830689—9). NTIS, PC A02/MF A01. Order Number DE84002374.

From 14. international symposium on multiparticle dynamics; Lake Tahoe, NV, USA (22 Jun 1983).

We review the status of the hypothesis that all long distance contributions to the Drell-Yan cross section can be absorbed into parton distribution functions.

1495 **Asymptotic behavior of the fixed-angle on-shell quark scattering amplitudes in non-Abelian gauge theories.** Sen, A. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 860-875(15 Aug 1983).

In this paper we find the asymptotic behavior of the fixed-angle on-shell quark-quark scattering amplitude in non-Abelian gauge theories in the limit of very large center-of-mass energy $\sqrt{s}$. We sum the perturbation series to all orders in the coupling constant and all powers of lns, but ignore terms which are suppressed by a power of s order by order in perturbation theory. In the $s\to\infty$ limit the amplitude vanishes as exp(-α lns ln lns), where α is a constant. The phase of the amplitude is shown to be free from infrared divergences. Hence the phase is a perturbatively calculable function and may provide important tests of QCD.

1496 **Properties of a classical confining medium in SU_2 gluon dynamics.** Ralston, J.P.; Sivers, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 953-964(15 Aug 1983). Contract W-31-109-ENG-38.

We examine the properties of a classical non-Abelian system which can be interpreted as the ground state of an extended polarizable medium in Euclidean space. The medium is characterized by the value of two scalar order parameters, G/sub munu//sup a/ (G/sub munu//sup a/ = 0 and (1/4)G/sub munu//sup a/G/sub munu//sup a/ = $3\sigma^2/g^2$. Starting from the assumption of time independence and spherical symmetry, we are able to find solutions to the classical field equations obeying these constraints and give simple analytic expressions for the vector potential, field-strength tensor, and polarization current in various gauges. We discuss gauge invariants formed from the fields and show that the classical analogs of Wilson loops display an area-law behavior.

1497 **Large-order behavior of lattice strong-coupling expansions.** Bender, C.M.; Mead, L.R.; Simmons, L.M. Jr. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 936-952(15 Aug 1983).

We examine the lattice strong-coupling expansion for the ground-state energy of the quantum-mechanical Hamiltonian (1/2)p^2+g'x'/sup α/, $\alpha>0$. We are interested in the large-order behavior of this series for various values of α. Treated as a quantum field theory, this simple model provides a laboratory for investigating the fascinating subtleties that arise when there are cancellations among graphs. The parameter α distinguishes between regions in which these cancellations occur with varying degrees of complexity. This paper considers various approaches to this very difficult problem and presents a partial solution.

1498 **(DESY-L-Trans—277) Production of polarized vector mesons in colliding e^+e^--beams.** Rekalo, M.P. May 1983. Translation of KFTI—83-2. 14p. Available from Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

Translated from Russian.

Within the framework of the single-photon mechanism, we found density matrix elements of vector mesons in $e^+ + e^- \to V + P$ and $e^+ + e \to A + P$ (A, V and P are axial, vector and pseudoscalar mesons). The density matrix elements have been calculated in two systems: in the rest system of V or A and in the CMS of e^+e^- beams. Since the reaction $e^+ + e^- \to V + P$ is defined by one electromagnetic formfactor only, the matrix elements of V-mesons in $e^+ + e^- \to V + P$ can be calculated precisely (without drawing upon information on the electromagnetic structure of hadrons). P-odd effects for the single-photon mechanism of polarized vector meson production in the reaction $e^+ + e^- \to V + P$ have been investigated, too.

6453 Particle Invariance Principles And Symmetries

1499 **(BNL—33648) Left-right symmetry in weak interactions: present status.** Senjanovic, G. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 12p. (CONF-8306125—2). NTIS MF A01. Order Number DE84001473.

From 4. Adriatic meeting on particle physics; Dubrovnik, Yugoslavia (6 Jun 1983).

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The basic features of the left-right symmetric electroweak theory are reviewed. The experimental situation regarding the scale M/sub R/ of the breakdown of parity is summarized. I further discuss in detail the connection with weak and strong CP violation and especially, grand unification. Also covered are the issues of cosmological domain walls and the compositeness of quarks and leptons. 57 references.

1500 (CERN—83-02(Vol.2), pp 55-65) **Charged current weak interaction of polarized muons.** Smadja, G.; Veszter-gombi, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 1 tab. and 2 figs.

The polarization of the muon beam can be used to test the presence of right-handed couplings in charged current interaction of muons in process $\mu+N\to\nu+X$. The experimental feasibility and the limits which can be obtained on the mass of right-handed intermediate boson are discussed.

1501 (CERN—83-02(Vol.2), pp 66-82) **Hadron production in deep inelastic muon scattering.** Montgomery, H.E. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

With 18 figs.

Future possibilities of physics with the final state hadron system in muon scattering are considered in the light of work done so far at the SPS and planned for the Tevatron.

1502 (CERN—83-02(Vol.2), pp 270-271) **CP violations and rare kaon decays.** Pakvasa, S. (Hawaii Univ., Honolulu (USA)); Ellis, J. (European Organization for Nuclear Research, Geneva (Switzerland)); Stanford Linear Accelerator Center, CA (USA)); Nanopoulos, D.V. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Feb 1983. NTIS (US Sales Only), PC A23/MF A01. (CONF-821256—Vol.2).

From Workshop on SPS fixed-target physics in the years 1984-1989; Geneva, Switzerland (6 Dec 1982).

Published in summary form only.

1503 **(DOE/ER/40048—74-L3) Nuclear probes of fundamental symmetries.** Adelberger, E.G. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1983. Contract AC06-81ER40048. 21p. (CONF-830833—3). NTIS, PC A02/MF A01. Order Number DE84001501.

From International conference on nuclear physics; Florence, Italy (29 Aug 1983).

Portions are illegible in microfiche products.

Nuclear experiments which probe the parity (P) and time-reversal (T) symmetries and lepton-number conservation are reviewed. The P-violating NN interaction, studied in the NN system and in light nuclei, provides an unique window on $\Delta S=0$ hadronic weak processes. Results are in accord with expectations. Sensitive searches for T-violation via detailed balance, T-odd correlations in γ and β-decay, and a possible neutron electric dipole moment (EDM) are discussed. No T-violation is observed. The EDM limit is almost good enough to eliminate one of the leading theoretical explanations for CP violation. Experimental dies of double β-

decay are reviewed. Although $\beta\beta$ nu nu decay has been convincingly detected in geochemical experiments there is no evidence for the lepton number violating $\beta\beta$ decay mode.

1504 **Conservation laws in the monopole-induced baryon-number-violating processes.** Sen, A. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 876-881(15 Aug 1983).

Monopole-induced baryon-number-violating processes are analyzed using the conservation laws for the ordinary and the chiral charge densities. It is shown that in the strictly massless limit reactions of the form $u_1+M\rightarrow u_2$/sup c/$+d_3$/sup c/$+e^+ +M$ are ruled out by these conservation laws. This, however, does not mean that the baryon-number-violating processes are suppressed, since reactions of the type $u_1+u_2+M\rightarrow d_3$/sup c/$+e^+ +M$ may take place even if the incoming u_1 and u_2 do not have any appreciable overlap in their wave functions. The role of the Adler-Bell-Jackiw anomaly in the baryon-number-violating processes is investigated. It is shown that the baryon-number violation takes place because of nontrivial boundary conditions at the monopole core, and is independent of the existence of the Adler-Bell-Jackiw anomaly. We may have chirality-conserving as well as chirality-nonconserving baryon-number-violating processes. It is also shown that the inclusion of extra Coulomb energies, e.g., weak or electromagnetic Coulomb energies, cannot qualitatively change the baryon-number-violating effects.

6454 Field Theory

REFER ALSO TO CITATION(S) 1490, 1493, 1494, 1495, 1496, 1497, 1581, 1606

1505 **(BONN-HE—83-7) Lattice degeneracies of geometric fermions.** Raszillier, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). May 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751332.

We give the minimal numbers of degrees of freedom carried by geometric fermions on all lattices of maximal symmetries in d = 2, 3, and 4 dimensions. These numbers are lattice dependent, but in the (free) continuum limit, part of the degrees of freedom have to escape to infinity by a Wilson mechanism built in, and 2sup(d) survive for any lattice. On self-reciprocal lattices we compare the minimal numbers of degrees of freedom of geometric fermions with the minimal numbers of naive fermions on these lattices and argue that these numbers are equal.

1506 **(CONF-8306131—1) Meson dynamics in large-N limit.** Tan, C.I. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1983. Contract AC02-76ER03130. 9p. NTIS, PC A02/MF A01. Order Number DE84001293.

From Asia Pacific Physics conference; Singapore, Singapore (12 Jun 1983).

The large-N limit of QCD with matter fields present is considered in a Hamiltonian loop space approach. The semi-classical nature of the large-N limit is clarified where a valence approximation emerges naturally. A pseudospin algebra is introduced for handling fermions.

1507 **(DESY—83-046) Screening of colour charge in numerical hopping parameter expansion.** Montvay, I.; Joos, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1983. 24p. Available from Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

The screening of the quark-antiquark potential by dynamical quark-antiquark pairs is numerically investigated in SU(2) colour gauge theory with Wilson fermions. The expected qualitative behaviour is born out by a high order hopping parameter expansion. The screening length is about 0.8 fermi and the dissociation energy of a heavy quark-antiquark pair is near 600-800 MeV.

1508 **(DOE/ER/01545—339) Chiral symmetry breaking in lattice electrodynamics.** Bartholomew, J.; Shenker, S.H.; Sloan, J.; Kogut, J.; Stone, M.; Wyld, H.W.; Shigemitsu, J.; Sinclair, D.K. (Chicago Univ., IL (USA). James Franck Inst.; Illinois Univ., Urbana (USA). Dept. of Physics; Ohio State Univ., Columbus (USA). Dept. of Physics; Notre Dame Univ., IN (USA). Dept. of Physics). Sep 1983. Contract AC02-76ER01545. 38p. NTIS, PC A03/MF A01. Order Number DE84001762.

Chiral symmetry breaking is studied in lattice quantum electrodynamics in the quenched approximation by computer-simulation methods. Simulations at zero temperature show that <anti psi psi> in non-zero for all couplings e^2 greater than a critical value e^2/sub c/. The sensitivity of <anti psi psi> to short-distance features of the lattice Action is studied by simulating variant gauge Actions. Simulations on asymmetric lattices do not reveal significant temperature dependence in the symmetry-breaking dynamics. Subtle effects and limitations of quenched calculations are discussed.

1509 **(EFI—524(11)-82) Gauge fields as metrical coefficients of laminated space.** Prokhorenko, E.B. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704247.

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Metrical properties of the lamination over the basis M a space-time with a layer G/H, where G is the inner symmetry group, and H is the isotropy subgroup, are considered. The conditions of the laminar metric consistency with lamination structure are studied. An action is obtained for the gauge field in the presence of a gravitational field as a laminated space curvature, obtained from the laminar metric, plus a cosmological term in lamination. The cosmological term is needed to compensate the constant curvature of the homogeneous space G/H.

1510 **(EFI—531(18)-82) Reggeon field theory at D = 2. Part 1 One-loop approximation.** Eremyan, Sh.S.; Nazaryan, A.Eh. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 66p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83704248.

Paper copy only, copy does not permit microfiche production6 refs.; 12 figs.

A general method of constructing an explicit representation is developed for the pomeron propagator in the presence of additional parameters, such as the pomeron production threshold x_{i_0}, momentum transfer K vector or the intercept shift $delta_0$. The method is shown to be applicable in both one-loop and two-loop approximations. The obtained general formulae allow to consider the pomeron propagator in both asymptotic region and the region of the perturbation theory applicability, and, besides, they provide the smooth matching of both these regions. The observed values are calculated, and the results connected with asymptotically high energies are being discussed.

1511 **(IFUSP-P—292) Form factors, charge distribution and the measurement aspect.** Marques, G.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1981. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704252.

Some aspects of the measurement problem in Relativistic Quantum Field Theory are analysed. Although, as suggested in the pioneering work of Bohr and Rosenfeld, what is measurable in Q.F.T. are non local (smeared) operators, no attempt has been made, as yet, in establishing a connection between these objects and quantities which are accessible experimentally, like Form Factors. An attempt is made in this direction.

1512 **(JINR—E-2-82-680) Dimensional regularization of supergraphs.** Avdeev, L.V.; Kamenshchik, A.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704260.

8 refs.; 1 tab.; submitted to the journal Phys. Lett., B.

The applicability region of the supersymmetric dimensional regularization is determined in the Wess-Zumino model. To achieve it, a consistent version of the regularization for supergraphs is formulated.

1513 **(SLAC-PUB—3168) New particles and interactions.** Ellis, J. (Stanford Linear Accelerator Center, CA (USA)). Jul 1983. Contract AC03-76SF00515. 28p. (CONF-830689—8). NTIS, PC A03/MF A01. Order Number DE84001444.

From 14. international symposium on multiparticle dynamics; Lake Tahoe, NV, USA (22 Jun 1983).

It is intended to indicate how multiparticle dynamics might serve as a valuable means of advancing our knowledge down the more fundamental line of elementary particle physics. The point of view is taken that the Standard SU(3) x SU(2) x U(1) Model is well established, and is now ripe to be used as a tool for analyzing physics beyond the Standard Model. The tool kit should include reliable and efficient ways of distinguishing gluon jets from quark jets, and of discriminating between t,b,c and light quark jets. What the author considers to be the most topical physics issues arising from the recent confirmation of the Standard Model are reviewed. These include the need for dynamical principles which go beyond the gauge princple, and in particular a satisfactory mechanism for gauge symmetry breaking. Some of the ideas proposed for solving these problems, such as technicolor and supersymmetry (SUSY), are reviewed, together with some of the experimental tests that can be performed. SUSY is examined in detail, and some ways of looking for sparticles in e^+e^- and anti pp collisions are discussed. The author tries to emphasize the crucial role to be played by the multiparticle jet tools in resolving some hot physics issues. It is seen in particular that the ability to discriminate heavy quark jets with high efficiency will be important, as will be good calorimetry and the ability to select (veto) events with (out) leptons. 57 references. (WHK)

1514 **Quantum dynamics of Kaluza-Klein theories.** Appelquist, T.; Chodos, A. (J. W. Gibbs Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 772-784(15 Aug 1983). Contract AC02-76ER03075.

Some of the quantum properties of Kaluza-Klein theories are studied. The classical features of these theories are reviewed, and the quantization of the gravitational field in an arbitrary number of dimensions is described. These results are then applied to a detailed analysis of the five-dimensional Kaluza-Klein model. The fifth dimension is taken to be compact and a quantum effective potential, as a function of the five-five component of the metric, is constructed. It is argued that the one-loop computation is reliable as long as the distance around the fifth dimension is large compared to the Planck length. The effective potential separates into two pieces: an induced cosmological constant, independent of the size of the fifth dimension, and a distance-dependent "Casimir" energy. The cosmological term is subtracted, leaving an attractive Casimir potential which will contract the fifth dimension to a size on the order of the Planck length. Consequences of this result are discussed and some of the ways in which it can be generalized are outlined.

1515 **Cavity quantum chromodynamics.** Hansson, T.H.; Jaffe, R.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 882-907(15 Aug 1983). Contract AC02-76ER03069.

We develop practical and rigorous techniques for calculating and renormalizing loop diagrams in quantum chromodynamics defined in a static spherical cavity. Working with Feynman propagators and in the Feynman gauge, we use multiple-reflection expansions for the cavity propagators to isolate and analyze the short-distance singularities in graphs. Nonsingular contributions to graphs are evaluated using a set of "Feynman rules" in an energy—angular-momentum representation. As an application we describe the calculation of the quark self-energy to lowest order in α/sub s/. We show that the self-energy of a confined massless quark is finite and unambiguous, and that all divergences in the case of a massive quark can be absorbed into a state-independent mass renormalization just as in free space.

1516 **Exact fermion-dyon scattering solutions.** Marciano, W.J.; Muzinich, I.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 973-976(15 Aug 1983). Contract AC02-76CH00016.

We analyze the Dirac equation for an I = (1/2) fermion in the field of an SU(2) Julia-Zee dyon. In the Prasad-Sommerfield limit we obtain exact J = 0 partial-wave solutions for massless fermions. These solutions describe charge-exchange scattering as well as dyon decay via charged-fermion-pair emission. When the initial fermion-dyon Coulomb interaction is repulsive, low-momentum single-particle J = 0 scattering is prohibited. Implications of our results for proton decay catalysis by SU(5) dyons are briefly discussed.

1517 **Effective Hamiltonians in the large-N limit.** Karim, O.A. (Department of Physics, Brown University, Providence, Rhode Island 02912). *Physical Review [Section] D: Particles and Fields;* **28**: No. 4, 1036-1038(15 Aug 1983). Contract AC02-76ER03130.

Lattice gauge theories are considered in the large-N limit. Two different approaches for obtaining an effective Hamiltonian are studied and compared. The gauge-volume approach is shown to differ from the collective-field one, and therefore the two may not yield the same large-N limit. It is argued that the collective formalism is the correct one.

1518 **Faddeev-Popov zeros and confinement of color in a hyperspherical gauge model.** Cutkosky, R.E. (Physics Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review Letters;* **51**: No. 7, 538-541(15 Aug 1983).

A new rotationally invariant Hamiltonian method, formulated on a four-dimensional hyperspherical surface, is proposed for the numerical study of quantum gauge field models. It is shown that in the Coulomb gauge it is sufficient, as well as necessary, to restrict transverse potentials to the zero-free domain of the Faddeev-Popov determinant. Numerical studies of an SU(2) model support Gribov's suggestion that the zeros provide a natural way to understand the origin of confinement.

1519 **Exact operator solution of the quantum Liouville field theory.** Braaten, E.; Curtright, T.; Thorn, C. (Physics Department, University of Florida, Gainesville, Florida 32611). *Annals of Physics (New York);* **147**: No. 2, 365-416(May 1983). Contract AS05-81ER40008.

Exact, closed form results are given expressing the quantum Liouville field theory in terms of a canonical free pseudoscalar field. The classical conformal transformation properties and Baechlund transformation of the Liouville model are briefly reviewed and then developed into explicit operator statements for the quantum theory. This development leads to exact expressions for the basic operator functions of the Liouville field: partial/sub μ/Phi, and e/sup n/phi. An operator product analysis is then used to construct the Liouville energy-momentum tensor operator, which is shown to be equal to that of a free pseudoscalar field. Dynamical consequences of this equilvalence are discussed, including the relation between the Liouville and free field energy eigenstates. Liouville correlation functions are partially analyzed, and remaining open questions are discussed.

65 PHYSICS RESEARCH

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 1503

1520 **(DOE/ER/05034—6) Experimental nuclear physics. Progress report, August 1982-August 1983.** Hamilton, J.H. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). 1983. Contract AS05-76ER05034. 17p. NTIS, PC A02/MF A01. Order Number DE84001454.

The research activities of the experimental nuclear structure group at Vanderbilt for the period August 1982 to August 1983 are reported. Research continues in the areas of, (a) in-beam γ-ray spectroscopy including cooperations with scientists at Oak Ridge, University of Koeln, Max Planck Inst./Heidelberg, GSI/Darmstadt, University of Florida and Florida State University; (b) studies of nuclei far from stability at UNISOR and at the on-line He refrigerator at the Leuven on-line separator; (c) pre-equilibrium (massive transfer) emission processes in fusion reactions at ORNL; (d) nucleon transfer reaction studies with scientists at ORNL, Los Alamos and Brookhaven; (e) electron scattering on ^{180}Hf at MIT Bates Laboratory; (f) δ-electron spectroscopy at the Max Planck Institute in Heidelberg; (g) theoretical studies with scientists at University of Frankfurt, Brookhaven, Lawrence Berkeley and ORNL; and (h) other studies. (WHK)

1521 **(DOE/ER/70035—6) Nuclear chemistry progress report, September 1, 1982-August 31, 1983.** Loveland, W.D. (Oregon State Univ., Corvallis (USA)). Sep 1983. Contract AT06-76ER70035. 64p. NTIS, PC A04/MF A01. Order Number DE84001546.

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The following intermediate-energy (10 to 100 MeV/A) and relativistic (> 250 MeV/A) heavy-ion reactions were studied: Au target fragmentation; interaction of 35 MeV/nucleon ^{12}C with ^{197}Au and ^{238}U, target fragment angular distributions in interaction of 86 MeV/nucleon ^{12}C with ^{197}Au, incomplete and complete fusion at intermediate energies (reaction of ^{154}Sm with ^{16}O and ^{12}C), heavy target fragmentation, U target fragmentation at intermediate and high energies, rare earth (holmium) target fragmentation, target fragment angular distributions for 25.2 GeV ^{12}C + ^{197}Au, ^{139}La + ^{139}La reaction at 245 MeV/nucleon, target fragment kinematics in interaction of 1.8 GeV/nucleon ^{40}Ar with ^{197}Au and ^{238}U, and a radiochemical search for anomalons. (DLC)

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 1472, 1528, 1581

1522 **(BONN-HE—83-1) Experimental investigation of the deuteron photodisintegration in the Δ-resonance region.** Arends, J.; Gassen, H.J.; Hegerath, A.; Mecking, B.; Noeldeke, G.; Prenzel, P.; Reichelt, T.; Voswinkel, A.; Sapp, W.W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Feb 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751333.

Differential cross sections for the deuteron photodisintegration process were measured for photon energies between 200 and 440 MeV using the tagged photon beam facility of the Bonn 500 MeV synchrotron. At eight angles between 18° and 145° charged particles were detected simultaneously in time-of-flight spectrometers consisting of scintillation counters. Above the resonance region the measured cross sections agree fairly well with earlier results, whereas there are larger discrepancies at low photon energies.

1523 **(JINR—E-4-82-572) sub(Δ)sup(5)He nucleus and Δ-^{4}He scattering.** Belyaev, V.B.; Musakhanov, M.M.; Rakhimov, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703670.

The problem of overbinding of the nucleus sub(Λ)sup(5)He and low energy Λ scattering by ^{4}He is studied. The five-body problem (Λ+4N) is considered on the basis of the strong coupling channel using the Schwinger variational principle.

1524 **(LA-UR—83-2653) Few-body experiments with polarized beams and polarized targets.** Simmons, J.E. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-830862—8). NTIS, PC A02/MF A01. Order Number DE84001333.

From 10. international conference on few-body problems in physics; Karlsruhe, F.R. Germany (21 Aug 1983).

A survey is presented concerning recent polarization experiments in the elastic p-d, p-^{3}He, and p-^{4}He systems. Mention is made of selected neutron experiments. The nominal energy range is 10 to 1000 MeV. Recent results and interpretations of the p-d system near 10 MeV are discussed. New experiments on the energy dependence of back angle p-d tensor polarization are discussed with respect to resolution of discrepancies and difficulty of theoretical interpretation. Progress is noted concerning multiple scattering interpretation of forward p-d deuteron polarization. Some new results are presented concerning the p-^{3}He system and higher energy p-^{4}He polarization experiments. 52 references.

1525 **(UNIGRAZ-UTP—07-82) Photodisintegration of the deuteron and the deuteron wave functions.** Crepinsek, L.; Zingl, H.F. (Graz Univ. (Austria)). Aug 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703678.

We have calculated the differential cross-section in terms of the momentum wave functions of the deuteron. Our numerical results obtained with the wave functions of the Paris potential are qualitatively in agreement with results already published. With more experiments at certain angles and between 20 MeV < E/sub γ/ < 120 MeV it should be possible to decide which potential has the appropriate wave functions.

6513 Nuclear Properties And Reactions, A=6-19

REFER ALSO TO CITATION(S) 1580

1526 **(ITP—82-54-E) Study on O$^+$ state structure of ^{8}Be using the basis of cluster hyperspherical harmonics.** Vasilevsky, V.S.; Nesterov, A.V.; Filippov, G.F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1982. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703669.

A simple algorithm of extrapolation of the minimal approximation of K-harmonic method at the expense of the basis functions actual in view of a cluster model is proposed and realized by an example of the calculation of O$^+$ states of ^{8}Be. The harmonics with Ksub(min) <= K <= Ksub(min)+26 are used. The numerical results are discussed and compared with experimental data.

1527 **Measurements of nuclear deexcitation times down to 10^{-19} sec using crystal blocking of ^{16}O on diamond.** Gomez del Campo, J.; Shapira, D.; Biggerstaff, J.A.; Moak, C.D.; Miller, P.D.; Neskovic, N.; Fearick, R.W.; Sellschop, J.P.F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review Letters;* **51**: No. 6, 451-454(8 Aug 1983). Contract W-7405-ENG-26.

The crystal-blocking technique was used to measure the deexcitation times of the evaporation residues of 120-MeV ^{16}O on ^{12}C, emerging along the <110> axis of a 12-μm-thick diamond crystal. The extracted times ranged from 4 x 10^{-19} sec for Mg to 4 x 10^{-18} sec for N, and they are consistent with statistical-model predictions.

1528 **Strong E1 transitions in ^{9}Be, ^{11}Be, and ^{13}C.** Millener, D.J.; Olness, J.W.; Warburton, E.K.; Hanna, S.S. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 497-505(Aug 1983). Contract AC02-76CH00016.

The Doppler shift attenuation method has been used to make two measurements of the mean life of the ^{11}Be 320-keV level. The results are 150 +- 30 fs from the ^{9}Be(t,pγ) ^{11}Be reaction and 168 +- 17 fs from the ^{3}H(^{9}Be,pγ)^{11}Be reaction. The adopted value of 166 +- 15 fs, from the present and previous measurements, corresponds to an extremely strong E1 transition of 0.36 +- 0.03 W.u. The adopted energy of the ground state transition from this and previous measurements is 320.04 +- 0.10 keV. It is shown that the magnitude of this E1 transition can be understood on the basis of shell-model calculations only if realistic single-particle wave functions are used. A similar theoretical treatment is given for strong E1 transitions in ^{9}Be and ^{13}C.

1529 **Nuclear moments of ^{9}Li.** Correll, F.D.; Madansky, L.; Hardekopf, R.A.; Sunier, J.W. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 862-874(Aug 1983).

The ground-state magnetic dipole and electric quadrupole moments of the β emitter ^{9}Li (J/sup π/ = (3/2)$^{-}$, T/sub 1/2/ = 0.176 s) have been measured for the first time. Polarized ^{9}Li nuclei were produced in the ^{7}Li(t,p) reaction, using 5—6 MeV polarized tritons. The recoiling ^{9}Li nuclei were stopped either in Au foils or in $LiNbO_3$ single crystals, and their polarization was detected by measuring the β-decay asymmetry. Nuclear magnetic resonance techniques were used to depolarize the nuclei, and the resonant frequencies were deduced from changes in the asymmetry. The ^{9}Li dipole moment was deduced from the measured Larmor frequency in Au; the result, including corrections for diamagnetic shielding and the Knight shift, is 'μ' = 3.4391(6) μ/sub N/. The ratio of the ^{9}Li quadrupole moment to that of ^{7}Li was derived from their respective quadrupole couplings in $LiNbO_3$; the value is 'Q(^{9}Li)/Q(^{7}Li)' = 0. 88 +- 0.18. Both results are in agreement with shell model predictions.

1530 **Branching ratio in the decay of ^{7}Be.** Mathews, G.J.; Haight, R.C.; Lanier, R.G.; White, R.M. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 879-884(Aug 1983). Contract W-7405-ENG-48.

The branching ratio for ^{7}Be electron-capture decay to the first excited state in ^{7}Li has been measured by implanting a 20-MeV ^{7}Be beam into a silicon detector telescope and counting the subsequent γ decays with well calibrated Ge(Li) detectors. A branching ratio of 10.7 +- 0.2 % was obtained. This value is in agreement with past measurements but does not agree with a recently suggested higher value. Sources of uncertainties and implications for nuclear physics and astrophysics are discussed.

1531 **Branching ratio in the electron-capture decay of ^{7}Be.** Davids, C.N.; Elwyn, A.J.; Filippone, B.W.; Kaufman, S.B.; Rehm, K.E.; Schiffer, J.P. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 885-887(Aug 1983). Contract W-31-109-ENG-38.

The branching ratio for the electron-capture decay of ^{7}Be to the 478 keV state in ^{7}Li has been measured. ^{7}Be nuclei recoiling near zero degrees from the ^{1}H(^{7}Li,^{7}Be)n reaction were counted by and implanted into a Si detector placed in the focal plane of an Enge split-pole spectrograph. After determining the total number of implanted ^{7}Be nuclei from the pulse height spectrum, the absolute number of 478 keV γ rays was measured with a Ge(Li) detector. The resulting branching ratio of 10.61 +- 0.23 % agrees well with previous measurements.

1532 **Inelastic electron scattering from ^{9}Be.** Lourie, R.W.; Bertozzi, W.; Buti, T.N.; Finn, J.M.; Hersman, F.W.; Hyde, C.; Kelly, J.; Kovash, M.A.; Kowalski, S.; Hynes, M.V. . (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 489-496(Aug 1983).

The electromagnetic form factors have been measured for the lowest two T = (3/2) states in ^{9}Be at 14.393 and 16.976 MeV, the positive-parity state at 17.490 MeV, and a level of previously unknown J/sup π/ at 16.671 MeV. The range of effective momentum transfer is 0.9< or =q/sub e/< or =2.5 fm^{-1}. The data for the T = (3/2) states show considerable deviation from the results of intermediate-coupling shell-model calculations. In particular, for q/sub e/< or =1.5 fm^{-1}, where the M1 multipole dominates, the data lie well above these calculated values. There is some evidence that the state at 16.671 MeV has positive parity. The results of single-particle shell-model and Nilsson-model calculations are compared with the data for this state. The experimental form factor for the 17.490-MeV state can be fitted with single-particle shell-model results in the 2s-1d space.

1533 **Isovector M2 state observed in the ^{14}C(π^{-},γ) reaction.** Baer, H.W.; Bistirlich, J.A.; Crowe, K.M.; Dahme, W.; Joseph, C.; Perroud, J.P.; Lebrun, M.; Martoff, C.J.; Straumann, U.; Truoel, P. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 85745). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 761-771(Aug 1983).

The photon spectrum of the pion capture reaction ^{14}C(π^{-},γ) ^{14}B was measured with a resolution of 0.9 MeV full width at half maximum. A single strong transition is observed with γ-ray energy 115.70 +- 0.17 MeV, corresponding to a state in ^{14}B at 2.15 +- 0.17-MeV excitation. Comparisons with previous experiments and theoretical calculations identify this as the second T = 2,2^{-} state in mass-14 nuclei. The single strong transition has a measured branching ratio (11.1 +- 3.0) x 10^{-4}, which equals one-fifth of the shell-model prediction. The total radiative capture branching ratio is 0.68 +- 0.16%, which is a factor of 2 to 3 smaller than for other 1-p-shell nuclei.

1534 **Double differential inclusive hydrogen and helium spectra from neutron-induced reactions on carbon at 27.4, 39.7, and 60.7 MeV.** Subramanian, T.S.; Romero, J.L.; Brady, F.P.; Watson, J.W.; Fitzgerald, D.H.; Garrett, R.; Needham, G.A.; Ullmann, J.L.; Zanelli, C.I.; Brenner, D.J. (Crocker Nuclear Laboratory and Department of Physics, University of California, Davis, California 95616). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 521-528(Aug 1983).

Double differential cross sections for the neutron-induced production of p, d, t, ^{3}He, and alpha particles from carbon have been measured using unpolarized neutrons. Neutron beam energies of 27.4, 39.7, and 60.7 MeV were used. The charged particle energy spectra at nine laboratory angles—15, 20, 35, 40, 45, 65, 90, 130, and 150 deg—range up to the kinematic maximum, from a lower energy cutoff of 4 MeV for p, d, t, and alpha and 8 MeV for ^{3}He. A CH target was used so that the absolute normalization was obtained simultaneously from the n-p cross sections. Intranuclear cascade plus deexcitation calculations were carried out. The data are compared with these calculations and with available proton induced (charge symmetric) reaction spectra.

1535 **(n,charged particle) reactions on 1p-shell nuclides at 14 MeV.** Haight, R.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). pp 510-511 of Neutron-capture gamma-ray spectroscopy and related topics 1981. von Egidy, T.; Goennenwein, F.; Maier, B. (eds.). Bristol, England; Institute of Physics (1982). (CONF-810920—).

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The reactions (n,p), (n,d), (n,t) and (n,α) of 14-Mev neutrons with several 1p-shell nuclides: ^{9}Be, ^{12}C, ^{14}N and ^{16}O have been investigated. Typical spectra are given for alpha particles from ^{9}Be and ^{12}C.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 1472

1536 **(CRN-PN—83-02) Low lying yrast states of ^{32}S.** Freeman, R.M.; Haas, F.; Beck, C.; Niemeskern, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703679.

From angular correlation measurements with the ^{30}Si(α,γ)^{34}S reaction the 6762-keV level has been assigned Jsup(π) = 5^{-}. Four new levels of ^{32}S have been observed at Esub(x) = 7567-, 8345-, 9464- and 9637-keV. The 7567-keV level has been assigned Jsup(π) = 5^{+} and the 8345-keV level is a good candidate for the lowest 6^{+} state. The two higher levels are probably negative parity high spin states.

1537 (DOE/ER/40048—75-L3) l-Forbidden Gamow-Teller decay of ^{39}Ca. Adelberger, E.G.; Osborne, J.L.; Swanson, H.E.; Brown, B.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.; Michigan State Univ., East Lansing (USA). Cyclotron Lab.). 1983. Contract AC06-81ER40048. 37p. NTIS, PC A03/MF A01. Order Number DE84001547.

The intensities of γ-rays emitted following the β^+ decays of ^{39}Ca and ^{35}Ar were measured by using a Ge(Li) detector to detect the delayed radiation from a KCl target bombarded by 13-MeV protons. From these results the experimental log(ft) values and related B(GT) values for the ^{35}Ar and ^{39}Ca decays are deduced. These are compared with shell-model calculations together with a recent computation by Towner and Khanna of the higher-order corrections due to configuration-mixing outside the sd shell, isobar currents and other meson-exchange currents. We concentrate on the significance of the l-forbidden 1d/sub 3/2/ - 2s/sub 1/2/ Gamow-Teller transition in mass 39 and comment on its relation to the corresponding M1 transitions in ^{39}Ca and ^{39}K. 38 references.

1538 (JINR—R-4-82-396) Application of folding model to description of low energy proton scattering on deformed nuclei. Ivanova, S.P.; Knyaz'kov, O.M.; Khrisanfov, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703675.

On the basis of the folding model formalism a calculation scheme is developed which permits to calculate in a simple way the contribution of exchange and many-particle correlations into interaction of low energy nucleons with deformed nuclei. Differential cross sections of elastic and inelastic excitation 2_1^+ state scattering of 23.95 and 17.5 MeV protons on a ^{26}Mg nucleus target are calculated. Satisfactory description of experimental angular distributions is obtained. The role of exchange and many-particle correlations in forming cross sections of scattering to large angles is studied. The contribution of the direct mechanism into 9.1 MeV proton scattering on ^{26}Mg is calculated. The relation between quadrupole deformation of a nucleus and potential and mechanisns of inelastic proton scattering is analysed.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 1537, 1537, 1544

1539 (DOE/ER/40048—76-L3) Depolarization in proton inclusive inelastic scattering and in the (vector d, vector p) reaction on medium weight nuclei. Weitkamp, W.G.; Halpern, I.; Trainor, T.A.; Lamoreaux, S.K.; Liu, Z.Y. (Washington Univ., Seattle (USA); Lanzhou Univ. (China)). 1982. Contract AC06-81ER40048. 27p. NTIS, PC A03/MF A01. Order Number DE84001503.

The energy-averaged depolarization parameter K/sub y// sup y'/ has been measured for the inelastic scattering of 18 MeV protons from ^{54}Fe, ^{63}Cu and ^{92}Mo at 45°, 90° and 135°, and for 14.35-MeV protons from ^{63}Cu at 45° and 135°. In all cases K/sub y//sup y'/ varies from approximately unity for scattering with low-energy loss to approximately zero for inelastic scattering to high excitation energies. The change from one of these values to the other occurs over a region ≃ 6 MeV wide centered at about 5-MeV excitation. A simple two-component model fits both the K/sub y//sup y'/ and inelastic cross-section data. K/sub y//sup y'/ has also been measured for the ^{54}Fe(vector d, vector p)^{55}Fe reaction with 16-MeV deuterons incident. Here K/sub y//sup y'/ changes from approximately the maximum possible value, 2/3, to about zero in a 6-MeV region centered at roughly 13-MeV excitation. The (vector d, vector p) data can be fitted by an extension of the model used for the proton-scattering data.

1540 ^{12}C on ^{48}Ca transfer reactions: A test of the effective Q-value model. Petersen, J.F.; Ascuitto, R.J.; Kovar, D.G.; Henning, W.; Sanders, S.J. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 710-716(Aug 1983).

Angular distributions for the ^{48}Ca(^{12}C,^{11}B)^{49}Sc and ^{48}Ca(^{12}C,^{13}C)^{47}Ca transfer reactions at E/sub lab/ = 45 MeV are presented. The data are analyzed in the context of the effective Q-value model, which has previously been applied successfully to ^{16}O induced reactions on ^{48}Ca. The model accounts equally well for the observed behaviors of the ^{12}C+ ^{48}Ca system, provided the influence of the strong inelastic transition to the first excited 2^+ (4.43 MeV) state in ^{12}C is taken into account.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 1539, 1544

1541 (JINR—E-3-82-336) Contributions of spin channels in neutron p-resonances of yttrium. Nikolenko, V.G.; Samosvat, G.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1982. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703681.

From 3. International symposium on neutron induced reactions; Prague (Czechoslovakia) (1982).

The contributions of spin channels in 10 p-resonances of ^{89}Y with spin 1 in the neutron energy range 2.6-30 keV were determined using the angular dependence of scattered neutrons.

1542 Search for short-lived anomalons in projectile fragmentation p. Gustafsson, H.A.; Gutbrod, H.H.; Kolb, B.; Ludewigt, B.; Poskanzer, A.M.; Renner, T.; Riedesel, H.; Ritter, H.G.; Warwick, A.I.; Wieman, H.H. (Gesellschaft fuer Schwerionenforschung, D-1600 Darmstadt, West Germany and Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **51**: No. 5, 363-365(1 Aug 1983). Contract AC03-76SF00098.

An anomalous short mean free path for projectile fragments has been observed in emulsions. The effect disappears in the first few centimeters and it has been suggested that the disappearance is due to a lifetime effect. The projectile fragmentation yields from a solid and dilute Cu target bombarded by 1.7-GeV/u ^{56}Fe have been measured and it is concluded that the disappearance of the effect is not due to decay.

1543 Overlapping β decay and resonance neutron spectroscopy of levels in ^{87}Kr. Raman, S.; Fogelberg, B.; Harvey, J.A.; Macklin, R.L.; Stelson, P.H.; Schroeder, A.; Kratz, K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review* [*Section*] *C: Nuclear Physics;* **28**: No. 2, 602-622(Aug 1983).

Energy levels in ^{87}Kr have been studied, with special emphasis on the unbound region, using two different methods. The first method comprises neutron capture and transmission measurements on an enriched gas target of ^{86}Kr using neutron time-of-flight techniques. In this way, neutron widths were determined for 39 resonances below 400 keV and capture areas for 14 resonances below 90 keV. The second method is a decay study of 56-s ^{87}Br in which a level scheme for ^{87}Kr has been established that shows 126 levels in the bound and 12 levels in the unbound region. A detailed comparison amongst the neutron resonance, the γ-ray decay, and available delayed neutron results has been made. Almost a one-to-one correspondence exists between the currently observed p-wave resonances below 250 keV and levels in ^{87}Kr studied through delayed neutron emission. The overall β-strength distribution derived from the present data shows broad resonancelike structures. However, no marked selectivity is observed in the β decay to individual levels in the unbound region of ^{87}Kr. The neutron capture cross section of ^{86}Kr is found to be about 5 mb for 30-keV neutrons with a Maxwellian energy distribution. The future of delayed neutron spectroscopy as a new tool for obtaining level-density information is discussed.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 509, 509, 509, 509, 1539, 1554, 1555, 1676

1544 **(ANL/NDM—80) Neutron total cross section measurements in the energy region from 47 keV to 20 MeV.** Poenitz, W.P.; Whalen, J.F. (Argonne National Lab., IL (USA)). May 1983. Contract W-31-109-ENG-38. 35p. NTIS, PC A03/MF A01. Order Number DE84001440.

Neutron total cross sections were measured for 26 elements. Data were obtained in the energy range from 47 keV to 20 MeV for 11 elements in the range of light-mass fission products. Previously reported measurements for eight heavy and actinide isotopes were extended to 20 MeV. Data were also obtained for Cu (47 keV to 1.4 MeV) and for Sc, Zn, Nd, Hf, and Pt (1.8 to 20 MeV). The present work is part of a continuing effort to provide accurate neutron total cross sections for evaluations and for optical-model parameterizations. The latter are required for the derivation of other nuclear-data information of importance to applied programs. 37 references.

1545 **(CONF-821143—8) Survey of the population of the entry states in fusion reactons.** Sarantites, D.G.; Dilmanian, F.A.; Jaeaeskelaeinen, M.; Puchta, H.; Woodward, R.; Beene, J.R.; Barker, J.H.; Halbert, M.L.; Gaardhoje, J.J.; Lindblad, T. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA); Niels Bohr Inst., Copenhagen (Denmark); Stockholm Univ. (Sweden). Fysiska Institutionen). 1982. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01. Order Number DE84001388.

From High angular momentum properties of nuclei conference; Oak Ridge, TN, USA (2 Nov 1982).

The population of the entry states from fusion reactions induced by ^{20}Ne and ^{50}Ti is investigated for a large number of reaction systems. Entrance channel l-distributions leading to fusion are deduced. The limiting angular momentum imparted to the evaporation residues is investigated as a function of Z and A. Fission plays a dominant role in determining the distributions in the evaporation residues. The effect of other mechanisms is also discussed. Prominent variations in the observed population distributions in (E*, M/sub γ/) space are attributed to nuclear structure effects.

1546 **(DOE/ER/04052—63) Population and decay of high-spin states in $^{157-161}$Yb: evolution of nuclear shapes as a function of spin and neutron number.** Jaeaeskelaeinen, M.; Sarantites, D.G.; Dilmanian, F.A.; Woodward, R.; Puchta, H.; Beene, J.R.; Halbert, M.L.; Hattula, J.; Hensley, D.C.; Barker, J.H. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 17p. (COO—4050-63). NTIS, PC A02/MF A01. Order Number DE84001395.

The population and decay of the entry states in $^{157-161}$Yb and $^{155-158}$Er from the reactions of 136- and 149-MeV ^{20}Ne with ^{144}Nd and ^{146}Nd have been investigated with the Spin Spectrometer gated with a Ge detector. Statistical-model calculations reproduce the main features of the entry state populations. The entry lines, <E*> as a function of multiplicity, M/sub γ/, show changes in slope at high M/sub γ/ which are due to changes in the decay mode as a result of changes in nuclear structure. Energy spectra of the continuum γ-rays and angular distributions as a function of M/sub γ/ show the onset of a dipole component localized at 650 +- 100 keV accompanied by an equally intense quadrupole component at twice the energy that continues to evolve to higher energies with increasing multiplicity. For ^{157,158,159,160,161}Yb the dipole component appears at M/sub γ/ = 21, 22, 23, 25, and 27 (at spin I $\cong$ 38, 40, 42, 45, and 50), respectively. At precisely these multiplicities the entry lines show a decrease in slope. In ^{158}Yb the dipole component disappears at M/sub γ/ = 28 and the entry line resumes its original slope. The results are consistent with the following picture. At low spins for ^{157,158}Yb the nuclear shapes evolve from prolate to slightly oblate particle-aligned structures. At I $\cong$ 38, 40, 42, 45, and 50 the ^{157,158,159,160,161}Yb nuclei, respectively, develop high-K rotational bands which may be built on oblate structures with large deformation ($\epsilon \cong 0.3$). At I = 49 a transition to triaxial shape appears to occur in ^{158}Yb. 22 references.

1547 **(DOE/ER/40007—19) Nuclear chemistry progress report.** (Indiana Univ., Bloomington (USA)). Sep 1983. Contract AC02-81ER40007. 35p. NTIS, PC A03/MF A01. Order Number DE84002359.

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The activities of the nuclear chemistry program at Indiana University during the period September 1, 1982 to August 31, 1983 are reviewed. As in the past, these investigations have focused on understanding the properties of nucleus-nucleus collisions at low-to-intermediate energies. During the past year new programs have been initiated at the National Superconducting Cyclotron Laboratory at Michigan State University and the Hollifield Heavy-Ion Research Facility at Oak Ridge. With the unique beams provided by these accelerators we have extended our previous studies of energy dissipation phenomena into new energy regimes. The MSU measurements, performed with E/A = 15 to 30 MeV ^{14}N beams, combined with recent results we have obtained at IUCF, have indicated the existence of a saturation in the average amount of linear momentum that can be transferred in nucleus-nucleus collisions. This saturation value is about 140 (MeV/C)/A and occurs at beam energies in the E/A $\sim$ 30 to 50 MeV range for ^{3}He- to ^{20}Ne-projectiles. At HHIRF, studies of the ^{56}Fe + ^{56}Fe reaction at E/A = 14.6 MeV have provided additional evidence for structure in the energy spectra of projectile-like fragments formed in symmetric collisions. Studies of near-barrier ^{56}Fe-induced reactions have continued at the Lawrence Berkeley Laboratory SuperHILAC.

1548 **(JINR—E-1-82-718) Experimental study of the pion-xenon nucleus collisions without particle production at 3.5 GeV/c momentum: general data.** Strugalski, Z.; Pavlak, T.; Pluta, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703680.

There exist pion-xenon nucleus collision events in which intensive emission of fast protons, of kinetic energy of about 20-400 MeV, is observed only without particle production. Energy, momentum and angular distributions of the emitted protons are presented and analysed in classes of events with various proton emission intensity. It is concluded that: a)the nucleon emission proceeds independently of the particle production process; b)the observed intensive emission of the "fast" protons cannot be treated as a result of a simple knocking-out of the nucleons from the target by the incident hadron.

1549 **(JINR—R-7-82-707) Correlations of two alpha particles in the sup(nat)Ag + sup(40)Ar(286 MeV).** Artyukh, A.G.; Avdejchikov, V.V.; Gridnev, G.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1982. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703682.

In the reaction sup(nat)Ag + ^{40}Ar (285 MeV) the angular and kinetic energy correlations between two α-particles in one plane and in two reciprocally normal planes have been measured. The angular momentum value has been estimated for the heavy reaction product which is the main source of α-particles. Evidence for "massive" transfer reactions induced by ^{40}Ar ions has been found. It has been established that the α-particle coincidence probability decreases if α-particles are emitted at backward angles in one plane and on one beam side.

1550 **(KIYI—82-1) Trial to defect the laser radiation effect on the interaction of neutrons with ^{139}La atomic nuclei.** Vertebnyj, V.P.; Razbudej, V.F.; Sidorov, S.V.; Muravitskij, A.V.; Vorona, P.N. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1982. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703683.

Transmission of ^{139}La sample placed in the radiation field of CO_2-laser is measured on the neutron time-of-flight spectrometer. No satellite resonances near the resonance at 0.734 eV, expected according to the Zaretsky-Lomonosov theory, were detected. One of the suggested causes of the experimental data discordance with theory is that the indicated resonance is considered to be p-resonance but in fact it can be s-resonance.

1551 **(ORNL/TM—8863) Cross sections for the Mo(n,xn) reactions between 3 and 21 MeV.** Bell, Z.W. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01. Order Number DE84002379.

Differential cross sections for Mo(n,xn) reactions have been measured for incident neutron energies between 3 and 21 MeV and for secondary neutron energies between 2 and 21 MeV. The data are compared with current ENDF/B evaluated data and with experimental data of two recent measurements. Discrepancies with evaluation for E/sub n/ between 5 and 9 MeV are discussed but not resolved. The present data agree reasonably well with evaluation for E/sub n/ > 10 MeV and with previous experimental data for E/sub n/ = 4 MeV. 11 references.

1552 **Proton hole states in ^{95}Y and /sup 95,97,99/Nb.** Flynn, E.R.; Brown, R.E.; Ajzenberg-Selove, F.; Cizewski, J.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 575-586(Aug 1983).

The proton hole states of ^{95}Y and /sup 95,97,99/Nb have been studied by the (t,α) reaction using a polarized beam of 17 MeV tritons on targets of ^{96}Zr and /sup 96,98,100/Mo. The results yield a number of new levels as well as numerous new spin assignments based on the large analyzing powers characteristic of the (t,α) reaction. Examination of the systematics of the resulting level schemes indicates a tendency towards deformation with increasing neutron number, which is expected given the known deformed region above A = 100. However, ^{97}Nb is also clearly affected by the N = 56 subshell closure. This subshell closure has a major effect on the level structure of ^{96}Zr but is completely washed out in ^{98}Mo.

1553 **Atomic charge states of residual nuclei from compound nucleus reactions.** Freeman, W.S.; Ernst, H.; Geesaman, D.F.; Henning, W.; Humanic, T.J.; Kuehn, W.; Schiffer, J.P.; Zeidman, B.; Prosser, F.W. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 919-920(Aug 1983). Contract W-31-109-ENG-38.

The average energy-to-charge state ratios of evaporation residues from fusion of Ni+Sn are measured using an electrostatic deflector combined with ΔE-E particle identification. The deduced average atomic charge states are 5 to 13 units higher than the equilibrium values expected from stripping in the target, suggesting that nuclear decays outside the target foil play an important role. The importance of internal conversion in determining these anomalously high charge states is discussed.

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 1544, 1546, 1547, 1570

1554 **(CONF-820979—10) Research highlights from the Holifield Heavy Ion Research Facility.** Plasil, F. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE84001943.

From International conference on nucleus-nucleus collisions; East Lansing, MI, USA (27 Sep 1982).

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The purpose of this paper is to present the scope of research carried out at the new Holifield Heavy Ion Research Facility (HHIRF) at Oak Ridge. This will be accomplished with reference to several research projects currently underway. The areas of research represented are microscopic and macroscopic aspects of nuclear reactions and nuclear structure. In view of the scope of this conference, emphasis will be placed on nuclear reactions. A brief description of HHIRF is given, together with its current status. Microscopic aspects of reactions between nuclei are discussed with reference to the prospects for the study of giant resonances by means of heavy ions, and to studies of elastic and inelastic scattering of ^{60}Ni nuclei. Macroscopic aspects of nuclear reactions are illustrated by means of the study of collisions between ^{58}Ni nuclei at 15.1 MeV/u and by means of Spin Spectrometer (crystal ball) studies of the ^{19}F + ^{159}Tb reaction. Results are presented for lifetime measurements of high-spin states in ytterbium nuclei. (WHK)

1555 **(CONF-820979—11) Research highlights with the spin spectrometer.** Sarantites, D.G.; Jaeaeskelaeinen, M.; Dilmanian, F.A.; Puchta, H.; Woodward, R.; Beene, J.R.; Hensley, D.C.; Halbert, M.L.; Hattula, J.; Barker, J.H. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA); Texas A and M Univ., College Station (USA)). 1982. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE84002070.

From International conference on nucleus-nucleus collisions; East Lansing, MI, USA (27 Sep 1982).

The excitation energy and angular momentum dependence of the entry states in fusion reactions measured with the spin spectrometer is discussed. A new decay mode involving the onset of localized stretched dipole radiation at half the accompanying stretched E2 collective radiation is found in $^{157-161}$Yb. The appearance of this mode correlates smoothly with neutron number and spin. Possible interpretations are presented in terms of the evolution of the nuclear shapes from prolate to aligned-quasiparticle oblate to collective oblate and then to triaxial. Evidence for nuclear deformation that increases with spin at very high excitation is presented based on α-particle angular distributions measured relative to the spin direction, using a new method for deriving the spin alignment.

1556 **(CONF-821143—9) Deformation of α-emitting nuclei from spin alignment with the spin spectrometer.** Dilmanian, F.A.; Sarantites, D.G.; Jaeaeskelaeinen, M.; Puchta, H.; Beene, J.R.; Hensley, D.C.; Halbert, M.L.; Adler, L.; Choudhury, R.K.; Namboodiri, M.N. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA); Texas A and M Univ., College Station (USA)). 1982. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE84001392.

From High angular momentum properties of nuclei conference; Oak Ridge, TN, USA (2 Nov 1982).

The Spin Spectrometer was used to measure the angular distribution of alpha particles with respect to the spin direction of residual nuclei from fusion of 176-MeV ^{20}Ne with ^{160}Nd. The results show an enhancement of the ratio of 90° to 0° alpha yields with respect to spin direction with decreasing E/sub α/ at subbarrier energies. This effect is not reproduced by statistical-model calculation made with transmission coefficients for spherical potentials, which may indicate that the α-emitting nuclei are deformed with their longest axis perpendicular to the spin direction. 15 references.

1557 **(DOE/ER/40048—79-L3) Half-life of ^{180}Ta in stellar environments.** Norman, E.B.; Kellogg, S.E.; Bertram, T.; Gil, S.; Wong, P. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1983. Contract AC06-81ER40048. 14p. NTIS, PC A02/MF A01. Order Number DE84001071.

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Some effects of high temperature and density on the half-lives of ^{180}Ta/sup g/ and ^{180}Ta/sup m/ have been investigated. It is found that the half-life of ^{180}Ta/sup g/ is greater in stellar environments than in the laboratory, while that of ^{180}Ta/sup m/ may be much shorter than its laboratory value. The implications of these results for the nucleosynthesis of ^{180}Ta are discussed. 23 references.

6519 Nuclear Properties And Reactions, A=190-219

REFER ALSO TO CITATION(S) 1544, 1547, 1570

1558 **(N—8321936) Analytic determinations of single-folding optical potentials.** Townsend, L.W.; Bidassaria, H.B. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Feb 1983. 14p. (NASA-TM—84611). NTIS, PC A02/MF A01.

A simple analytic method for calculating nucleon-nucleus optical potentials using a single folding of a Gaussian two body interaction with an arbitrary nuclear distribution is presented. When applied to proton-lead elastic scattering, the predicted real part of the Woods-Saxon potential is in substantial agreement with the ex-

perimentally determined phenomenological potential, although there are no adjustable parameters. In addition, the volume integrals of both real potentials are nearly identical.

1559 **Fission following capture reactions of $^{32}S+^{208}Pb$.** Tsang, M.B.; Ardouin, D.; Gelbke, C.K.; Lynch, W.G.; Xu, Z.R.; Back, B.B.; Betts, R.; Saini, S.; Baisden, P.A.; McMahan, M.A. (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 747-760(Aug 1983).

Fission fragment mass and angular distributions were measured for ^{32}S induced reactions on ^{208}Pb at the laboratory energies of 180, 210, 250, and 266 MeV. By measuring the folding angle distributions between coincident fissionlike fragments at several beam energies it is shown that essentially the entire mass of the projectile is transferred to the composite system, which subsequently decays via symmetric fission. With increasing projectile energy the width of the mass distribution increases approximately as the square root of the nuclear temperature. The energy dependence of the angle integrated fusion-fission cross sections can be well described by classical trajectory calculations using the proximity potential and one-body dissipation. The fission fragment angular distributions become more anisotropic with increasing beam energy. Even at the lowest energy of 180 MeV, the angular distributions are more anisotropic than expected from statistical model calculations using saddle point shapes of the rotating liquid drop model. A simple parametrization of the angular momentum dependence of the effective moment of inertia gives a consistent description of the energy dependence of the angular distributions.

1560 **Gamma-ray transitions among levels of ^{206}Pb.** Dickens, J.K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 916-918(Aug 1983). Contract W-7405-ENG-26.

A study of γ-ray data produced by neutron inelastic scattering from a lead sample enriched in the isotope ^{206}Pb has resulted in placements of 106 γ rays as transitions among 88 known or postulated levels of the ^{206}Pb level structure.

1561 **E2 isovector giant resonance as seen through the capture of fast neutrons.** Drake, D.M. (Los Alamos National Lab., NM (USA)); Aniol, K.; Halpern, I.; Storm, D. (Washington Univ., Seattle (USA)); Wender, S. (Duke Univ., Durham, NC (USA)); Nilsson, L. (Uppsala Univ. (Sweden)); Joly, S. pp 508-509 of Neutron-capture gamma-ray spectroscopy and related topics 1981. von Egidy, T.; Goennenwein, F.; Maier, B. (eds.). Bristol, England; Institute of Physics (1982). (CONF-810920—).

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The first observation of the E2 isovector resonance in a heavy nucleus using the (n,γ) capture reaction is reported. The observed reaction is $^{206}Pb(n,\gamma)\ ^{207}Pb$.

1562 **Study of the $^{208}Pb(n,\gamma_0)$ reaction between 0.8 and 5.9 MeV.** Joly, S.; Grenier, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)); Drake, D.M. (Los Alamos National Lab., NM (USA)); Rigaud, F. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). pp 514-515 of Neutron-capture gamma-ray spectroscopy and related topics 1981. von Egidy, T.; Goennenwein, F.; Maier, B. (eds.). Bristol, England; Institute of Physics (1982). (CONF-810920—).

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The $^{208}Pb(n,\gamma_0)$ reaction was studied from 0.8 to 5.9 MeV to investigate the relative contributions of the compound-nucleus and direct-semidirect (DSD) processes in this energy range. A second objective was to search for a possible excitation of the M1 giant resonance when comparing the measured asymmetry factors for the ground-state transition to the predictions of the DSD model.

6520 Nuclear Properties And Reactions, A=220 And Above

REFER ALSO TO CITATION(S) 1544, 1547

1563 **(DOE/ER/40048—78-L3) Review of the fission decay of the giant resonances in the actinide region.** Harakeh, M.N. (Washington Univ., Seattle (USA). Nuclear Physics Lab.; Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 1983. Contract AC06-81ER40048. 31p. (CONF-830970—2). NTIS, PC A03/MF A01. Order Number DE84001544.

From International symposium on highly excited states and nuclear structure; Orsay, France (5 Sep 1983).

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The fission decay of giant resonances in the actinide region is reviewed. Results from various experiments which are invariably conflicting are discussed. These include inclusive electron and positron-induced fission, as well as experiments in which fission fragments were detected in coincidence with inelastically scattered electrons or hadrons. Attention is focussed on a recent (α,α'f) experiment in which the fission decay of the giant monopole inelastically scattered α-particles at and around 0°. 49 references.

1564 **(KFK—3511-B) Measurement of the space- and angle-dependent spectra of fast neutrons and secondary charged particles from spallation-reactions of 590 MeV protons in thick uranium targets.** Raupp, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kern- und Teilchenphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Apr 1983. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE83751317.

At SIN time-of-flight measurements have been performed to determine the yields of neutrons and charged particles emitted from a 10 cm x 10 cm x 40 cm long uranium target bombared with 590 MeV protons from the SIN cyclotron. Measurements were made at angles of 30°, 90° and 150° relative to the incident proton beams for different penetration depths of protons into the target. The detector was a NE213 liquid scintillator. Beside the measurement of the yields of leakage neutrons the used time-of-flight method permitted also to determine the yields of emitted charged particles. Differential spectra of secondary protons, deuterons and pions have also been measured and analysed at 6 penetration depths of the proton beam into the target and at 3 angles (30°, 90° and 150°).

1565 **(KIYI—81-38) Exponent sum transformation into sum of trigonometrical functions with the purpose in order to determine the decay constants.** Lyalina, D.I.; Merinets, T.I.; Sikora, D.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1981. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703676.

Methods of time distribution transformation as exponent sum into sums of trigonometrical functions are given. The decay constants of multicomponent activities of delayed neutrons at ^{232}Th and ^{235}U photofission are estimated from extremal values of transformed functions.

1566 **(LA-UR—83-3074) Prompt fission neutron spectra and average prompt neutron multiplicities.** Madland, D.G.; Nix, J.R. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 36p. (CONF-8310104—2). NTIS, PC A03/MF A01. Order Number DE84001724.

From Specialists meeting on yields and decay data of fission product nuclides; Upton, NY, USA (24 Oct 1983).

We present a new method for calculating the prompt fission neutron spectrum N(E) and average prompt neutron multiplicity anti nu/sub p/ as functions of the fissioning nucleus and its excitation energy. The method is based on standard nuclear evaporation theory and takes into account (1) the motion of the fission fragments, (2) the distribution of fission-fragment residual nuclear temperature, (3) the energy dependence of the cross section σ/sub c/ for the inverse process of compound-nucleus formation, and (4) the possibility of multiple-chance fission. We use a triangular distribution in residual nuclear temperature based on the Fermi-gas model.

This leads to closed expressions for N(E) and anti nu/sub p/ when σ/sub c/ is assumed constant and readily computed quadratures when the energy dependence of σ/sub c/ is determined from an optical model. Neutron spectra and average multiplicities calculated with an energy-dependent cross section agree well with experimental data for the neutron-induced fission of ^{235}U and the spontaneous fission of ^{252}Cf. For the latter case, there are some significant inconsistencies between the experimental spectra that need to be resolved. 29 references.

1567 **Strong and weak coupling to the octupole deformed mode in $^{227}Ac_{89}$.** Sheline, R.K.; Leander, G.A. (Department of Nuclear Physics, Research School of Physical Sciences, Australian National University, Canberra, Australian Capital Territory 2600, Australia and Florida State University, Tallahassee, Florida 32306). *Physical Review Letters;* **51**: No. 5, 359-362(1 Aug 1983). Contract AC05-76OR00033.

Hybrid values of the intrinsic gyromagnetic ratio and the absolute values of the decoupling parameters have been found for two sets of approximately degenerate opposite parity bands with $K = (3/2)^{+-}$ and $K = (1/2)^{+-}$ in ^{227}Ac, as would be expected for intrinsic parity mixing in the single-particle states due to octupole deformation. These properties are able to test quantitatively the change in the Nilsson wave functions resulting from octupole deformation.

1568 **Neutron fission cross sections of ^{239}Pu and ^{240}Pu relative to ^{235}U.** Weston, L.W.; Todd, J.H. (Oak Ridge National Laboratory, Bldg. 6010, P.O. Box X, Oak Ridge, Tennessee 37830). *Nuclear Science and Engineering;* **84**: No. 3, 248-259(Jul 1983).

The ratios of the neutron fission cross sections σ /SUB f/ (^{240}Pu)/σ /SUB f/ (^{239}Pu), σ /SUB f/ (^{240}Pu)/ σ /SUB f/ (^{235}U), and σ /SUB f/ (^{239}Pu)/σ /SUB f/ (^{235}U) have been measured simultaneously with a multiplate ionization fission chamber using the Oak Ridge Electron Linear Accelerator as a neutron source over the neutron energy range from 5 keV to 20 MeV. The ^{240}Pu ratio data are in overall agreement with ENDF/B-V with exceptions in relatively narrow neutron energy regions. Below 150 keV and from 10 to 20 MeV, the present ^{239}Pu/^{235}U fission ratios indicate significant discrepancies when compared to ENDF/B-V. These ratios are important for thermal and fast reactor applications.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 1387, 1558, 1566

1569 **(IC—82/210) Electromagnetic polarisabilities of the nucleon.** Harun ar Rashid, A.M. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703666.

The dynamic electric and magnetic polarisabilities of the nucleon are calculated taking the photon-nucleon resonance vertex-function ambiguity parameters into account. The annihilation channel in the Compton scattering amplitude is also evaluated from the chiral effective Lagrangian. It is found that the electric and magnetic polarisabilities of the proton are of the same order of magnitude.

1570 **(IC—82/211) Quasimolecular treatment of light-particle emission in incomplete-fusion reactions.** Christov, C.V.; Petkov, I.J.; Delchev, I.I. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703667.

The light-particle emission in incomplete-fusion reactions has been analyzed within the framework of a simple model in which the fusion process plays an important role. A quasimolecular interpretation of the fusion has been employed in the model. The numerical results are in good agreement with the experimental data both at forward and backward angles for the reactions ^{159}Tb(^{14}N,α), ^{209}Bi(^{14}N,α) both at the energy 115 MeV and ^{197}Au(^{22}Ne,α) at the energy 178 MeV.

1571 **(IFT-P—14/81) Path integral approach for the nuclear collective motion.** Galetti, D.; Mizrahi, S.S.; Pimentel, B.M. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). Dec 1981. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704250.

A procedure is developed for treating a nuclear collective motion via the path integral formalism by defining a collective propagator in the 'phase space' of the collective subspace. This collective subspace is projected out of the full many-body Hilbert space by an approach of the Generator Coordinate Method. Under the approximation of quadratic 'momentum' dependence the propagator is written in the coordinate representation from which the collective schrodinger equation is derived in terms of a canonical pair P and Q.

1572 **(INIS-mf—8566) Coherence of neutron fields.** Ledinegg, E.; Schachinger, E. (Technische Univ., Graz (Austria)). 1982. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83703668.

Glauber's definition of quantum coherence is used for neutron fields under the assumption that the complete occupation number space is a direct product of Fermi subspaces. As a result completely coherent microfields are obtained which define a density operator in full analogy to Glauber's P-representation of Boson fields. For better physical significance a transformation from the P-representation to a momentum representation is performed. It is proved that the second order coherence function in this representation is equivalent to Wolf's second order coherence function of a classical Dirac field. Finally, the results of the theory are used to calculate explicity the second order coherence function and the coherence time of an ideally collimated neutron beam.

1573 **(JINR—R-2-82-695) Nuclear matter near the critical point of pion condensation.** Bunatyan, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1982. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703671.

Near by the pion condensation critical point, the nucleon and Δ-isobar self-energy part in nuclear matter caused by the interaction with the pion field is investigated for various temperatures. It is pointed out, that the pion field closeness to the instability leads to the divergence of these quantities. Owing to that, the properties of the nuclear matter near by the pion condensation critical point change totality.

1574 **(JINR—R-2-82-696) Properties of nuclear matter nearby the pion condensation critical point.** Bunatyan, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1982. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703672.

The nucleon and Δ-isobar self-energy-part investigations by means of the quantum statistical methods gives evidence that the nuclear matter properties changes totally near the by the pion condensation critical points; in particular, there are no one-quasiparticle states in nuclear matter. The physical consequences of the obtained results and the possibility of its experimental observations are discussed. It is demonstrated that the nucleon and Δ-isobar properties changes reverse influence on the pion field leads, in its turn, to a decisive change of its properties, in particular, makes impossible for any temperature and density the reducing to zero of the pion mode frequency.

1575 **(JINR—R-4-82-209) Dynamic amplification of the parity nonconservation effects for the compound states and giant 0^- resonances.** Kadmenskij, S.G.; Markushev, V.P.; Furman, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1982. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703673.

It is shown that the mechanism of the dynamic enhancement of the parity nonconservation effects for neutron resonances connected with mixing by weak interaction the main components of wave functions of adjacent compound states of the same spines and opposite particles contradicts the information about structure of neutron resonances. The new mechanism of the mixing based on

the excitation of giant 0sub(-)-resonances by weak interaction is proposed. Some experimental consequences of such mechanism are discussed.

1576 **(JINR—R-4-82-385) Application of the local-scale transformation method in the Hartree-Fock theory.** Petkov, I.Zh.; Stoitsov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703674.

The local-scale transformation method is applied to the Skyrme- Hartree-Fock theory for the description of the ground state of the spherical nuclei. Instead of the system of large number of integro-differential equations for the one-particle wave functions, we solve just one equation for the function of the local scale transformation. For a number of nuclei the binding energy, the one- particle energies, the nucleon densities and the geometrical characteristics of the ground state are calculated. The results agreed well with the exact ones from the Hartree-Fock theory. The method may be applied for a systematical investigation in the field of heavy and super heavy nucleie nuclear fission and heavy ion physics, where the direct application of the Hartree-Fock method is very difficult.

1577 **(KFK—3539) Application of the algebraic programming system REDUCE 2 to calculations in the nuclear cluster model.** Beck, R.; Dickmann, F.; Oehlschlaeger, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik). May 1983. 69p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE83751321.

The paper shows to which extent algebraic calculations in the nuclear cluster model may be performed on a computer. After setting up the nuclear model, the calculation of relevant nuclear matrix elements is discussed. For simple cases, this is done by hand while more general examples are calculated analytically by the computer. Various REDUCE programs are presented to demonstrate the feasibility of the method.

1578 **(N—8323140) Heavy-ion total and absorption cross sections above 25 MeV/nucleon.** Townsend, L.W.; Wilson, J.W.; Bidasaria, H.B. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Apr 1983. 44p. (NASA-TP—2138; L—15566). NTIS, PC A03/MF A01.

Within the context of a double-folding optical potential approximation to the exact nucleus-nucleus multiple-scattering series, eikonal scattering theory is used to generate tables of heavy ion total and absorption cross sections at incident kinetic energies above 25 MeV/nucleon for use in cosmic ray high-energy heavy ion transport and shielding studies. Comparisons of predictions with nucleus-nucleus experimental data show excellent agreement except at the lowest energies, where the eikonal approximation may not be completely valid. Even at the lowest energies, however, agreement is typically within 20 percent.

1579 **(UNIGRAZ-UTP—05-83) Coulomb plus separable potential in coupled channels.** Schweiger, W.; Plessas, W.; Kok, L.P.; van Haeringen, H. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703677.

The two-potential formalism for long-range forces is generalized to coupled channels. Assuming the short-range potential to be separable we treat the proton-proton interaction in the coupled partial waves $^3P_2$-$^3F_2$. We derive the corresponding Coulomb-modified nuclear transition matrices in closed analytic form and calculate the Coulomb distortion of the phase shifts and of the mixing parameter. The separable parametrization proposed for the p-p interaction in $^3P_2$-$^3F_2$ yields an accurate fit to the experimental data available for these channels. The potential completes the description of the N-N interaction by the Graz-II separable model.

1580 **Nuclear binding energies from moment methods: Realistic effective no-core Hamiltonian.** Margetan, F.J.; Vary, J.P. (Ames Laboratory, Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 907-915(Aug 1983).

Total binding energies for nuclei with 14< or =A< or =18 are obtained from a realistic effective no-core Hamiltonian, H/sub eff/, using moment methods. The lowest few moments of H/sub eff/ are evaluated in an oscillator model space of four major shells. These moments are then used to determine a number of continuous and discrete density of states functions, each of which yields an estimate for the H/sub eff/ ground state energy. The adjustable discrete density of states functions which we introduce are based upon realistic single-particle Hamiltonians. With a reasonable selection of moment method ingredients we obtain good agreement between theory and experiment for relative binding energies within each A chain. The most stable isobar is correctly predicted in all cases and Coulomb energy differences are in close agreement with experiment. Thus, the valley of β stability is well reproduced in this approach with a simple overall shift in absolute binding energies for each A chain.

1581 **Reduced nuclear amplitudes in quantum chromodynamics.** Brodsky, S.J.; Hiller, J.R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 and The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 475-482(Aug 1983). Contract AC03-76SF00515;AC02-76ER02220;AC02-76ER01428.

We present a new formalism which systematically accounts for nucleon compositeness in nuclear scattering amplitudes, consistent with quantum chromodynamics and covariance. Reduced gauge-invariant nuclear amplitudes are defined which have elementary quantum chromodynamic scaling properties. The procedure is applied to the photodisintegration and electrodisintegration of the deuteron as a test of nuclear chromodynamics and as a method to isolate contributions of dibaryon resonances.

1582 **Dynamical thresholds for compound-nucleus formation in symmetric heavy-ion reactions.** Davies, K.T.R.; Sierk, A.J.; Nix, J.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 679-691(Aug 1983).

We study the effect of the nuclear macroscopic energy, nuclear dissipation, and shape parametrization on dynamical thresholds for compound-nucleus formation in symmetric heavy-ion reactions. This is done by solving numerically classical equations of motion for head-on collisions to determine whether the dynamical trajectory in a multidimensional deformation space passes inside the fission saddle point and forms a compound nucleus, or whether it passes outside the fission saddle point and reseparates. Specifying the nuclear shape in terms of smoothly joined portions of three quadratic surfaces of revolution, we take into account three symmetric deformation coordinates. However, in some cases we reduce the number of coordinates to two by requiring the ends of the fusing system to be spherical in shape. The nuclear potential energy of deformation is determined in terms of a Coulomb energy and a nuclear macroscopic energy that is usually taken to be a double volume energy of a Yukawa-plus-exponential folding function, although a double volume integral of a single-Yukawa folding function and ordinary surface energy are also considered. The collective kinetic energy is calculated for incompressible, nearly irrotational flow by means of the Werner-Wheeler approximation. Four possibilities are studied for the transfer of collective kinetic energy into internal single-particle excitation energy: (1) zero dissipation, (2) ordinary two-body viscosity, (3) one-body wall-formula dissipation, and (4) one-body wall-and-window dissipation. For systems with Z^2/A larger than a threshold value $(Z^2/A)_{thr}$ which depends somewhat upon dissipation, the center-of-mass bombarding energy must exceed the maximum in the one-dimensional interaction barrier by an amount ΔE in order to form a compound nucleus.

1583 **Nucleus-nucleus potential at close contact from fusion at "high" energies.** Gomez del Campo, J.; Satchler, G.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 952-954(Aug 1983).

We compile the results of analyses, based upon the potential barrier penetration model, of fusion cross section measurements at "high" energies (those on the high-energy side of the bend in the σ/sub fus/ vs 1/E/sub c.m./ plot). A systematic correlation between the critical radius R/sub cr/ and the potential V/sub cr/ at that radius is demonstrated. These results provide information about the nucleus-nucleus potential at smaller distances than is usually available from scattering and "low" energy fusion measurements. For some systems, nuclear potential depths of as much as -110 MeV are implied.

1584 **Role of finite boson number in the interacting boson approximation description of $\gamma \rightarrow g$ transitions in deformed nuclei.** Casten, R.F.; Warner, D.D.; Aprahamian, A. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 894-902(Aug 1983). Contract AC02-76CH00016.

The effect of finite boson number in the interacting boson approximation is one of its most distinguishing features. These effects are investigated in terms of the deviations of $\gamma \rightarrow g$ band E2 transitions from the rotational (Alaga) values which provide one of the most crucial tests of collective models of deformed nuclei. It is shown that the empirical systematics of these deviations displays a strong mass dependence, that the interacting boson approximation successfully reproduces these systematic trends, and does so primarily by virtue of the variations in boson number and not because of parameter variations. Moreover, the origin of the N dependence lies in the characteristic way in which the SU(3) symmetry is broken in calculations for realistic deformed nuclei and involves, in an essential way, the N dependence of the SU(3) $\gamma \rightarrow \beta$ transitions.

1585 **Dynamical groups of liquid drop models.** Gilmore, R.; Feng, D.H.; Vallieres, M.; Wood, J.L. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **28**: No. 2, 903-906(Aug 1983). Contract AS05-80ER10599.

Two inequivalent quantum mechanical versions of the liquid drop model can be obtained, depending on whether the classical volume conservation condition is imposed to first or second order. These two models have dynamical groups IU(5) and U(6), respectively. The two models are related to each other through standard group contraction and group expansion procedures.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 1053, 1103

1586 **(ANL/NESC—1016) DUST: thermal neutron streaming through square ducts.** Murthy, K.P.N.; Indira, R.; Shankar Singh, R. (Reactor Research Centre, Kalpakkam (India). Fast Reactor Group). [nd]. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049003.

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DUST simulates thermal neutron streaming through multilegged square concrete ducts in shields using the albedo Monte Carlo method. The albedo data used are in the form of empirical formulae based on measured double differential albedo data. Sampling of the reflected polar and azimuthal angles is by a rejection method. Variance reduction techniques such as Russian roulette are used. DUST can handle only thermal neutron.

1587 **(ANL/NESC—1017) PLACID: gamma radiation streaming through cylindrical ducts.** Murthy, K.P.N.; Indira, R. (Reactor Research Centre, Kalpakkam (India). Fast Reactor Group). [nd]. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049004.

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PLACID simulates gamma streaming through straight cylindrical ducts in shields. A straight cylindrical duct located in an infinite shield material is the geometry considered. Monte Carlo simulation is used with variance reduction devices such as Russian roulette and cutoff weight for history termination. For the simulation of Cartesian coordinate system is set up with the origin at the center of the duct mouth and the z-axis along the duct centerline. The source is a plane isotropic disc source, placed at the bottom of the duct. Photon point total cross sections are used. The Klein-Nishina formula is used to compute the differential scattering cross sections. The double rejection technique due to Kahn is employed for sampling the scattered photon energy and the scattering angle. Next event estimators are used for scoring the streaming flux.

1588 **(JINR—R-1-82-688) Longitudinal development of electron-photon showers produced by the Esub(γ)=(60-3000) Mev gamma quanta.** Slowinski, B.; Czaj, W.; Przybyszewska-Czaj, S.; Bancerek, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1982. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703663.

Using the experimental material obtained from pictures of xenon bubble chambers of JINR and ITEP (Moscow) the longitudinal distribution of ionization losses and the corresponding fluctuations in electron-photon showers (ES), produced by gamma-quanta with the energy Esub(γ)=(60-3000) MeV has been studied. Formula describing the average value of ionization losses and their fluctuations with respect of the depth in ES and of the energy of gamma-quanta induced the showers are presented.

1589 **(JINR—R-1-82-689) Transverse development of electron-photon showers produced by the Esub(γ)=(60-3000) MeV gamma quanta.** Slowinski, B.; Czaj, W.; Przybyszewska-Czaj, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1982. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83703664.

The results of investigation of electron shower ionization losses distribution in the direction normal to the development axis (DA) of electron-proton showers (ES) created by gamma-quanta within the Esub(γ)=(60-3000) energy range in liquid xenon are presented. Formula describing the average ionization losses distribution in a plane normal to the DA with respect to the distance from conversion point of ES producing gamma-quanta along the DA are obtained.

1590 **(LA—9751-MS) Comparison of S/sub n/ quadrature methods in benchmark criticality calculations.** Lee, C.E.; Carruthers, L.M. (Los Alamos National Lab., NM (USA)). Jul 1983. Contract W-7405-ENG-36. 169p. NTIS, PC A08/MF A01. Order Number DE84002294.

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A quadrature generation technique is formulated on the unit sphere for discrete ordinate transport programs. A computer code is developed for automation generation of weights and directions for arbitrary order n. Critical dimension predictions using the generated directed direction sets are compared with analytical transport solutions, P/sub n-1/, DP/sub (n-2)/2/, and EQ/sub n/ approximations in one-dimensional, one-group slabs, cylinders, and spheres. The k/sub eff/ of the six-energy group Lady Godiva spherical benchmark problem is critiqued using various set and solutions methods.

1591 **(LA-UR—83-2837) Performance of multilayer dispersion elements from 80 to 500 eV.** Bartlett, R.J.; Kania, D.R.; Trela, W.J.; Kaelline, E.; Lee, P.; Spiller, E. (Los Alamos National Lab., NM (USA); JET Joint Undertaking, Abingdon, Oxfordshire (UK); Ball Bros. Research Corp., Boulder, CO (USA). Aerospace Systems Div.; IBM Watson Research Center, Yorktown Heights, NY (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-8310172—1). NTIS, PC A02/MF A01. Order Number DE84001035.

From Advances in soft x-ray science and technology conference; Upton, NY, USA (17 Oct 1983).

We have measured the reflectivity of several multilayer dispersion elements between 80 and 500 eV. Two samples of ReW-C and one of Ni-C with 2d spacing of approximately 70 A and 150 A were tested at angles of incidence between 10° to 80°. Measurements were made by fixing the incident and reflected angles (Bragg) and scanning the photon energy. Theoretical analyses of these multilayers have also been made and the results are compared with the experimental measurements.

1592 **(N—8325505) Emission, absorption and polarization of gyrosynchrotron radiation of mildly relativistic particles.** Petrosian, V.; Mctiernan, J.M. (Stanford Univ., CA (USA)). May 1983. 22p. (NASA-CR—170338). NTIS, PC A02/MF A01.

Approximate analytic expressions are presented for the emissivity and absorption coefficient of synchrotron radiation of mildly relativistic particles with an arbitrary energy spectrum and pitch angle distribution. From these, an expression for the degree of polarization is derived. The analytic results are compared with numerical results for both thermal and non-thermal (power law) distributions of particles.

1593 **(N—8325525) Nucleon and deuteron scattering cross sections from 25 MV/Nucleon to 22.5 GeV/Nucleon.** Townsend, L.W.; Wilson, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1983. 26p. (NASA-TM—84636; L—15596). NTIS, PC A02/MF A01.

Within the context of a double-folding optical potential approximation to the exact nucleus-nucleus multiple-scattering series, eikonal scattering theory is used to generate tables of nucleon and deuteron total and absorption cross sections at kinetic energies between 25 MeV/nucleon and 22.5 GeV/nucleon for use in cosmic-ray transport and shielding studies. Comparisons of predictions for nucleon-nucleus and deuteron-nucleus absorption and total cross sections with experimental data are also made.

1594 **(ORNL/RSIC—5/V7) Bibliography, subject index, and author index of the literature examined by the Radiation Shielding Information Center. Volume 7.** Trubey, D.K.; Roussin, R.W.; Gustin, A.B. (Oak Ridge National Lab., TN (USA)). Aug 1983. Contract W-7405-ENG-26. 505p. NTIS, PC A22/MF A01. Order Number DE84001557.

An indexed bibliography of open literature selected by the Radiation Shielding Information Center since the previous volume was published in 1980 is presented in the area of radiation transport and shielding against radiation from nuclear reactors (fission and fusion), x-ray machines, radioisotopes, nuclear weapons (including fallout, and low energy accelerators (e.g., neutron generators). The bibliography was typeset from computer files constituting the RSIC Storage and Retrieval Information System. In addition to lists of literature titles by subject categories (accessions 6201-10156), an author index is given. Most of the literature selected for Volume VII was published in the years 1977 to 1981.

1595 **(SAND—83-0591C) Ion-beam analysis and ion implantation in the study of diffusion.** Myers, S.M. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 18p. (CONF-8310169—1). NTIS, PC A02/MF A01. Order Number DE84000354.

From Diffusion symposium; Philadelphia, PA, USA (2 Oct 1983).

High-energy ion-beam analysis has several desirable features for depth profiling of diffusion couples. The technique is nondestructive, it offers depth resolutions in the range 0.01 to 1 μm, and absolute measurements of both concentration and depth are achieved without the use of reference standards. Ion implantation provides a means for the initial formation of diffusion couples; through the athermal injection of solutes directly into hosts, this approach circumvents several difficulties associated with surface deposition. The application of ion beams to diffusion measurements are first discussed in general terms and then illustrated by two examples. In one case study the diffusion of ion-implanted Sn in Fe was observed by elastic backscattering analysis, thereby extending the range of measured diffusivities downward by 10^6 times. In the other investigation, nuclear reaction analysis was used to depth profile the decay product ^{3}He in stainless steels exposed to tritium; this permitted a determination of the tritium diffusivity at 273 K, where the migration rate is 10^3 times smaller than that detected previously through gas permeation methods.

1596 **Synchrotron X-ray diffraction applied to the study of physisorbed monolayers.** Nielsen, M.; Bohr, J.; Kjaer, K.; Als-Nielsen, J. (Risoe National Lab., Roskilde (Denmark)); McTague, J.P. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research;* **208**: No. 1-3, 549-554(15 Apr 1983). (CONF-820839—).

From International conference on X-ray and VUV synchrotron radiation instrumentation; Hamburg, F.R. Germany (9 Aug 1982).

The systems of physisorbed monolayers are primarily studied because of their approximate two dimensional character. By examples we shall show how synchrotron X-ray diffraction is applied to the study of crystalline order of rare gas atomic monolayer on graphite surfaces, and in particular how information may be obtained about fundamentals of two dimensional phase transitions.

1597 **Coherent states and the interaction of swift ions with condensed matter.** Echenique, P.M. (Barcelona Univ. (Spain). Facultad de Ciencias); Ashley, J.C.; Ritchie, R.H. (Oak Ridge National Lab., TN (USA)). *European Journal of Physics;* **3**: No. 1, 25-29(1982).

A swift ion moving through an electron gas is described in terms of the coherent states of the interacting system. This formulation is shown to lead simply to well known results for the wake potential generated in the medium by the passage of the ion and for the stopping power of a medium due to plasmon excitation.

6550 Medical Physics

REFER ALSO TO CITATION(S) 481, 1108, 1123, 1124, 1297

1598 **(BNL—33776) Stochastic basis for curve shape, RBE and temporal dependence.** Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)). 10 Aug 1982. Contract AC02-76CH00016. 27p. (CONF-8205231—1). NTIS, PC A03/MF A01. Order Number DE84001652.

From Radiation carcinogenesis conference; Bethesda, MD, USA (24 May 1982).

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This paper uses biophysical-microdosimetric quantities, measured in a physical surrogate or phantom cell, to explain the shape of absorbed dose-quantal cell response curves, the role of radiation quality and the influence of dose rate. Responses expected are explored first in simple autonomous cell systems, followed by increasingly-complex systems. Complications seen with increasingly-complex systems appear to be confined largely to the higher dose and dose rate ranges.

1599 **(BNL—33788) Combined hit theory-microdosimetric explanation of cellular radiobiological action.** Bond, V.P.; Varma, M.N. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 23p. (IAEA-SM—266/63; CONF-830450—3). NTIS, PC A02/MF A01. Order Number DE84001693.

From IAEA/WHO symposium on biological effects of low level radiation; Venice, Italy (11 Apr 1983).

Hit theory is combined with microdosimetry in a stochastic approach that explains the observed responses of cell populations

exposed in radiation fields of different qualities. The central thesis is that to expose a population of cells in a low-level radiation field is to subject the cells to the potential for interaction with charged particles in the vicinity of the cells, quantifiable in terms of the charged particle fluence θ. When such an interaction occurs there is a resulting stochastic transfer of energy to a critical volume (CV) of cross section σ, within the cell(s). The severity of cell injury is dependent on the amount of energy thus imparted, or the hit size. If the severity is above some minimal level, there is a non-zero probability that the injury will result in a quantal effect (e.g., a mutational or carcinogenic initial event, cell transformation). A microdosimetric proportional counter, viewed here as a phantom cell CV that permits measurements not possible in the living cell, is used to determine the incidence of hit cells and the spectrum of hit sizes. Each hit is then weighted on the basis of an empirically-determined function that provides the fraction of cells responding quantally, as a function of hit size. The sum of the hits so weighted provides the incidence of quantally-responding cells, for any amount of exposure θ in a radiation field of any quality or mixture qualities. The hit size weighting function for pink mutations in Tradescantia is discussed, as are its implications in terms of a replacement for RBE and dose equivalent. 14 references, 9 figures.

1600 **(DOE/EV/03522—26) Biological and clinical dosimetry. Progress report, October 1, 1982-August 31, 1983.** Laughlin, J.S.; Zeitz, L. (Sloan-Kettering Inst. for Cancer Research, New York (USA). Radiation Biophysics Lab.). 31 Aug 1983. Contract AC02-76EV03522. 30p. NTIS, PC A03/MF A01. Order Number DE83017643.

Portions are illegible in microfiche products.

Our results showed agreement between absorbed dose determined with a nonisolated-sensor polystyrene (PS) calorimeter and a PS paralled plate ion chamber (PPC) in a PS phantom for photon and electron fields. Similar calorimeters have been constructed with tissue equivalent A150 plastic and solid water equivalent (WT1) plastic. Depletion of dissolved molecular oxygen by 100 K rad of x-rays changed the thermal defect (TD) of A150 by 9.3%. The actual magnitude of TD for A150 in Co-60 gamma rays was obtained by assuming the true absorbed dose to be that obtained with the PS calorimeter. The PS calorimeter result agreed to 2% with that of a PS and an A150 PPC, when converted on the basis of differences in /sup rho/e and /sup μ/en/rho (the TD of PS changed by 1%, less than the experimental error, after 100 K rad of x-rays). TD for A150 was -4.4% (endothermic) immediately after 100 K rad dose and 5% (exothermic) when equilibrated with air. While a TD of -10% was obtained for WT1 in equilibrium with air. With electrons, charge accumulation in ion chamber electrodes contributes to polarity dependence. This was demonstrated in an A150 parallel plate chamber whose collector electrode was 1.4 g/cm^2 thick. With the top of the electrode at 0.8 g/cm^2 depth in A150, the fractional change of charge collection with polarity reversal went from -0.096 at 6 MeV to a small positive value at 20 MeV; at 2.3 g/cm^2 depth, in absolute value, it showed a maximum of absolute value of -0.076 for 9 MeV decreasing at lower and higher electron energies. Our results indicate that for such chambers in electron fields, except for small depths, e.g. 2 g/cm^2 at 20 MeV, the charge collected with negative polarity on the collector electrode should be used.

1601 **(NBS/SP—625) X-ray measurements and protection, 1913-1964.** Taylor, L.S. (National Bureau of Standards, Washington, DC (USA)). Dec 1981. 388p. NTIS, PC A17/MF A01 - GPO $9.00. Order Number DE84900261.

This report reviews the development of measurement standards and protection against x rays. The story of x rays can be divided into three periods up to 1925, a period of discovery, application, and a recognized new danger; up to 1955, a period of exploitation, measurement, control, and protection, and from then, a time of consolidation, public awareness, and political activism. This book is an account of how government and non-government organizations have worked together. Attention is directed to some of the changes and differences between government laboratory operations today and those in the first half of the 20th century. (ACR)

1602 **(NUREG/CR—3425) Low-energy photon dose deposition in tissue slab and spherical phantoms.** Nelson, R.F.; Chilton, A.B. (Illinois Univ., Urbana (USA). Nuclear Engineering Lab.). Sep 1983. 62p. NTIS, PC A04/MF A01 - GPO $4.50. Order Number DE84900174.

Monte Carlo computer codes were employed to calculate depth doses for parallel beams of low-energy, monoenergetic photons incident on slab and spherical phantoms. Photon energies ranged from 10 to 150 keV. Phantom compositions include: ICRU 4-element tissue, ICRU 10-element tissue, and a tissue-substitute plastic. Tabular data are presented for 0.007, 0.3 and 1.0 g/cm^2 depths. Results are compared with calculations of other workers and with experimental data available for the tissue-substitute plastic. 20 references, 22 figures, 17 tables.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 781

1603 **(HMI-P—83/2-HF(Preprint)) Dynamic recovery of magnetism in collision cascades: MnF_2.** Bertschat, H.H.; Haas, H.; Menningen, M.; Nielsen, K.B. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751324.

The time dependence of the hyperfine field at ^{19}F nuclei following implantation into MnF_2 has been studied by the perturbed angular distribution technique. The data show a partial destruction of the magnetic order in the collision cascade, attributed to electronic energy loss processes. The recovery of this magnetism defect can be accounted for by spin diffusion from the undisturbed regions of the crystal. The temperature dependence of the spin diffusion coefficient is consistent with a critical exponent of 0.7.

1604 **(LA-UR—83-2848) Optimal smoothing of site-energy distributions from adsorption isotherms.** Brown, L.F.; Travis, B.J. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 11p. (CONF-8305139—1). NTIS, PC A02/MF A01. Order Number DE84001016.

From Conference on fundamentals of adsorption; Bavaria, F.R. Germany (1 May 1983).

The equation for the adsorption isotherm on a heterogeneous surface is a Fredholm integral equation. In solving it for the site-energy distribution (SED), some sort of smoothing must be carried out. The optimal amount of smoothing will give the most information that is possible without introducing nonexistent structure into the SED. Recently, Butler, Reeds, and Dawson proposed a criterion (the BRD criterion) for choosing the optimal smoothing parameter when using regularization to solve Fredholm equations. The BRD criterion is tested for its suitability in obtaining optimal SED's. This criterion is found to be too conservative. While using it never introduces nonexistent structure into the SED, significant information is often lost. At present, no simple criterion for choosing the optimal smoothing parameter exists, and a modeling approach is recommended.

1605 **(PUC-TN—01/81) Transfer matrix theory for the optical absorption spectrum of mixed crystals.** Koiller, B.; Davidovich, M.A.; Silva, C.E.T.G. da. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jan 1981. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704266.

The density of states and optical absorption spectrum of linear mixed crystals in the one-dimensional alloy transfer matrix approximation are studied. Local modes, which are present in the single impurity limit, develop into collective modes by merging into a band as the impurity concentration increases. The composition dependence of local and collective like optical absorption peaks is discussed, and it is shown that qualitatively different behaviors are obtained for single band and split bands type density of states.

1606 Ising spin gauge theory at upper marginal dimensionality for spin glasses. Aeppli, G. (Massachusetts Inst. of Tech., Cambridge); Bhanot, G. *Journal of Physics C: Solid State Physics;* **14**: L593-L596(1981). Contract AC02-76CH00016.

The Ising spin gauge theory along its line of vanishing unit Wilson loop has been proposed as a model for spin glasses. We have performed Monte Carlo simulations to determine the phase diagram of this theory in six dimensions, the upper marginal dimensionality attributed to true spin glasses. As in three and four dimensions, the contour of vanishing Wilson loops does not meet a transition line for finite values of either the gauge or spin-spin coupling constant. We conclude that either the gauge theory analog is incorrect or the upper marginal dimension of spin glasses is not six.

6561 Superconductivity

REFER ALSO TO CITATION(S) 782, 783, 805, 806, 830, 853, 858, 990, 992, 993

1607 (SLAC-PUB—3213) Surface properties of metal-nitride and metal-carbide films deposited on Nb for RF superconductivity. Garwin, E.L.; King, F.K.; Kirby, R.E.; Aita, O. (Stanford Linear Accelerator Center, CA (USA); Osaka Prefectural Univ., Sakai (Japan)). Sep 1983. Contract AC03-76SF00515. 29p. (CONF-8309103—10). NTIS, PC A03/MF A01. Order Number DE84001491.

From 9. international vacuum congress and 5. international conference on solid surfaces; Madrid, Spain (26 Sep 1983).

Various effects occur which can prevent attainment of the high Q's and/or the high gradient fields necessary for the operation of rf superconducting cavities. One of these effects, multipactor, both causes the cavity to detune during filling due to resonant secondary electron emission at the cavity walls, and lowers the Q by dissipative processes. TiN deposited onto the high field regions of room temperature Al cavities has been used at SLAC to successfully reduce multipactor in the past. We have therefore studied TiN and its companion materials, NbN, NbC, and TiC, all on Nb substrates under several realistic conditions: (1) as deposited, (2) exposed to air, and (3) 1 keV electron-bombarded. The studied films (up to 14 nm thickness) were sputter deposited onto sputter-cleaned Nb substrates. Results indicate that the materials tested gave substantially the same results. The maximum secondary electron yields for as-deposited films was about 1.0 to 1.2. These yields rose to greater than 1.5 upon air-exposure and were reduced to nearly the pre-oxidized values after electron bombardment (about 3×10^{17} electrons-cm^{-2} in the case of NbN and NbC). XPS analysis showed that the oxides (e.g. TiO_2 in the case of TiN films) formed during air exposure were only slightly reduced (converted to lower oxides) by the electron beam exposure. AES showed a slight reduction in the surface O concentration following beam exposure. The results indicate that any of these films would be poor choices if simply deposited and exposed to air, but, in fact, the in-situ electron bombardment which occurs in cavities serves to reduce the effective secondary electron yield and thereby causes a substantial reduction in multipacting.

1608 Josephson tunneling and the proximity effect. Kresin, V.Z. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **28**: No. 3, 1294-1303(1 Aug 1983).

Josephson junctions containing one or two proximity systems (e.g., S/sub α/-M/sub β/-I-S/sub γ/, S/sub α/-M/sub β/-I-M/sub γ/-S/sub delta/; M(γ) is a normal metal or superconductor) are studied. An analysis of the thickness and temperature dependences of the maximum dc Josephson current I/sub M/ is carried out. The curvature of the function I/sub M/(L/sub β/) is found to depend strongly on the ratio of energy gaps ϵ/sub γ//ϵ/sub α/ and on the temperature. The analysis is based on the thermodynamic Green's-function method, and the effect of strong coupling is also taken into account. If the proximity system contains two superconductors S/sub α/ and S/sub β/, then it appears that the electron-phonon interaction described by the constant λ/sub β/ contributes noticeably even if T>T/sub c/β.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 1496, 1509, 1514

1609 (BONN-HE—83-3) Finite-size effects in the three-state quantum asymmetric clock model. Gehlen, G. v.; Rittenberg, V. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Apr 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83751312.

The one-dimensional quantum Hamiltonian of the asymmetric three-state clock model is studied using finite-size scaling. Various boundary conditions are considered on chains containing up to eight sites. We calculate the boundary of the commensurate phase and the mass gap index. The model shows an interesting finite-size dependence in connexion with the presence of the incommensurate phase indicating that for the infinite system there is no Lifshitz point.

1610 (CBPF-NF—043/81) Sequences of the groups D_4d. Zanette, S.I.; Caride, A.O. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1981. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704245.

The chains of the non-crystallographic point group D_4d are given in a form that simplifies symmetry adaptations and their application to molecular and solid state spectroscopy.

1611 (IFT-P—15/81) Parametrization of open systems with effective quadratic Hamiltonians plus stochastic force. Hernandez, E.S.; Mizrahi, S.S. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). Dec 1981. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83704251.

The evolution generated by general dissipative Hamiltonians is analyzed when a stochastic force is included. A mapping technique allows to easily write the equations of motion for the observables of interest. A general dissipativity condition is extracted, whose fullfilment guarantees that thermal equilibrium is reached as the final stage of the evolution. Several existing frictional Hamiltonians are examined and it is seen that the correlation of the fluctuating force is essential to the destruction of a constant of motion inherent to pure quantal behaviour.

1612 (IFUSP-P—295) Quantum non-local charge and exact s-matrix of the Gross-Neveu model. Abdalla, E.; Lima-Santos, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1981. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704253.

Using non perturbative methods we prove conservation of the non-local quantum charge of the Gross-Neveu model, providing an exact S-matrix.

1613 (IFUSP-P—297) Models with global or local supersymmetry - An introduction. Abdalla, E.; Jasinschi, R.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1981. 16p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704254.

General ideas of supersymmetry are presented. When the parameter of the transformation is made local, gauge fields are included, and gravitation comes about as a consequence.

1614 (IFUSP-P—303) Mermin-Wagner phenomenon and cluster properties of one-and two-dimensional systems. Bonato, C.A.; Perez, J.F.; Klein, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1981. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83704255.

Optimal conditions concerning the range of interactions for the absence of spontaneous breakdown of continuous symmetries for one- and two-dimensional quantum and classical lattice and continuum systems are given. For a class of models verifying infra-red bounds such conditions are necessary and sufficient. Using the same techniques bounds on clustering for systems with continuous symmetry are obtained a priori improving results of Jasnow and Fisher.

1615 **(IFUSP-P—306) Para-bosons and para-fermions in quantum mechanics.** Cattani, M.S.D.; Fernandes, N.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1981. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704256.

Within the framework of the ordinary quantum mechanics, a detailed study of the energy eigenfunctions of N identical particles using the irreducible representations of the permutation group in the Hilbert space has been performed. It is shown that the para-states, as occurs with the boson and fermion states, are compatible with the postulates of quantum mechanics and with the principle of indistinguishability. A mathematical support for the existence of para-bosons and para-fermions is given and in a certain sense, Gentile's quantum statistics is justified.

1616 **(IFUSP-P—307) New optical rotation dispersion formula.** Kimel, I. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1981. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704257.

A new dispersion formula for the rotatory power is obtained in the framework of Kubo formalism for transport coefficients. Unlike the well known Rosenfeld-Condon dispersion law, this formula is consistent with the free electron gas asymptotic behavior.

1617 **(IFUSP-P—309) Gaussian sum rules for optical functions.** Kimel, I. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1981. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704259.

A new (Gaussian) type of sum rules (GSR) for several optical functions, is presented. The functions considered are: dielectric permeability, refractive index, energy loss function, rotatory power and ellipticity (circular dichroism). While reducing to the usual type of sum rules in a certain limit, the GSR contain in general, a Gaussian factor that serves to improve convergence. GSR might be useful in analysing experimental data.

1618 (Juel—1787, pp 37-71) **Symmetric system of n spins s.** Rodriguez Dominguez, A.R. Jul 1983. (In German). NTIS (US Sales Only), PC A05/MF A01.

In Theory of two localized magnetic systems.

For systems with n identical particles of spin value s, in which the rotation and permutation symmetry hold, the problem of finding a system of commuting operators has been considered. This problem reduces to the one of finding a system of commuting operators in the enveloping algebra of SU(2s+1), using Weyl's decomposition of the Hilbert space into irreducible representations of Ssub(n) x SU(2s+1).

1619 **(Juel—1787) Theory of two localized magnetic systems.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Jul 1983. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780032.

Separate entries were prepared for the papers in scope for the data base. (WHK)

1620 **(UCID—19655) Mathematical and physical scaling of triggered lightning.** Ziolkowski, R.W.; Grant, J.B. (Lawrence Livermore National Lab., CA (USA)). Dec 1982. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01. Order Number DE84002480.

As the aircraft industry incorporates current technology in airborne systems, electromagnetic compatibility can decrease. Composite fuselages can be more transparent to EMP, whether nuclear or lightning generated, than metal ones. Solid-state circuitry is sensitive to intense EM fluctuations whereas mechanical controls generally are not. With this increased vulnerability comes increased concern for these dangers. Recently the anxiety over lightning has risen. Answers are sought to such questions as: how do the lightning EM effects couple into the aircraft's interior. Do aircraft trigger lightning, and if so, can the triggering be minimized. An understanding, at least to some extent, of lightning would provide a needed foundation to examine the interaction of aircraft with lightning. A review of the literature on lightning and lightning-aircraft investigations, including triggered lightning, was conducted and is briefly summarized in this paper. In addition to this brief literature review, scaling the lightning event to laboratory size is also discussed. The ability to scale would allow accurate investigation of lightning effects, as well as the triggering phenomena, in scaled experiments.

1621 **Are three-frequency quasiperiodic orbits to be expected in typical nonlinear dynamical systems?.** Grebogi, C.; Ott, E.; Yorke, J.A. (University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **51**: No. 5, 339-342(1 Aug 1983).

The current state of theoretical understanding related to the question posed in the title is incomplete. This paper presents results of numerical experiments which are consistent with a positive answer. These results also bear on the problem of characterizing possible routes to chaos in nonlinear dynamical systems.

1622 **Three-dimensional computer modeling of electromagnetic fields: A global lookback lattice truncation scheme.** Ziolkowski, R.W.; Madsen, N.K.; Carpenter, R.C. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Computational Physics;* **50**: No. 3, 360-481(Jun 1983). Contract W-7405-ENG-48.

A new lattice truncation scheme for the finite difference time domain approach to the solution of Maxwell's equations has been developed. The problem space is truncated near the sources and the field components on its boundary are generated from these field values known at retarded times on an interior surface one cell from it with an integral representation of the electromagnetic field. The numerical implementation of this global lookback scheme is discussed. Examples which have been used to determine its characteristics and its validity are given.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 1604, 1618

1623 **(SOL—83-15) Theorem about antiprisms.** Broadie, M.N. (Stanford Univ., CA (USA). Systems Optimization Lab.). Aug 1983. Contract AT03-76ER72018. 18p. NTIS, PC A02/MF A01. Order Number DE84001616.

This paper is concerned with the structure of the facets of an (n + 1)-dimensional polytope Q which is the convex hull of the dual n-polytopes P and P*. The motivation for studying the facets of Q comes froam the construction of subdivisions for PL homotopy algorithms. In general, the facets of Q may be quite arbitrary, but in some cases the facets of Q reflect the dual correspondence between the faces of P and P*. That is, the facets of Q may be generated by the convex hull of dual faces of P and P*. When this happens, Q is called an antiprism.

1624 **Deformation of the general zero-curvature equations associated to simple Lie algebras.** Kupershmidt, B.; Peterson, D. (CNLS, MS B258, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* **24**: No. 9, 2296-2300(Sep 1983).

We construct deformations and rational reductions for all the general zero-curvature equations associated to simple complex Lie algebras [known as AKNS equations for sl(2, C)].

1625 **Higher-order parabolic approximations to time-independent wave equations.** Corones, J.P.; Krueger, R.J. (Applied Mathematical Sciences, Ames Laboratory-USDOE and Department of Mathematics, Iowa State University, Ames, Iowa 50011). *Journal of Mathematical Physics (New York);* **24**: No. 9, 2301-2304(Sep 1983). Contract W-7405-ENG-82.

A sequence of numerically tractable higher-order parabolic approximations is derived for the reduced wave equation in an inhomogeneous medium. The derivation is motivated by a definition of waves propagating in a distinguished direction. For a homogeneous medium these definitions are exact and yield uncoupled, infinite-order parabolic equations which are equivalent to the wave equation. The difficulty of obtaining higher-order parabolic ap-

proximations for the elastic wave equation in an inhomogeneous medium is also discussed.

1626 **Coherence in chaos and caviton turbulence.** Doolen, G.D.; DuBois, D.F.; Rose, H.A.; Hafizi, B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **51**: No. 5, 335-338(1 Aug 1983). Contract AC03-76ET53057.

The chaotic nature of "caviton turbulence" is studied in one-dimensional, many—Fourier-mode numerical simulations of the driven dissipative Zakharov equations. Above the modulational instability threshold the system evolves into a variety of stable patterns of cavitons which become chaotic for stronger driving. The cavitons remain coherent for times long compared to the shortest Lyapunov time.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 481

7001 Plasma Research

1627 **(DOE/ET/51013—60) Annual technical report.** Yang, T.F.; Gierszewski, P. (eds.). (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 3 Dec 1982. Contract AC02-78ET51013. 163p. (PFC/RR—82-31). NTIS, PC A08/MF A01. Order Number DE84002277.

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This paper describes a Monte Carlo study of the thermal conductivity and impurity transport in a tokamak with an optimized bundle divertor configuration. This configuration has been designed to obtain the best plasma performance. When collisions and electric fields are included, the thermal conductivity was found to be 40% larger than that of an axisymmetric neoclassical value. Without a divertor the oxygen impurity was found to diffuse towards the center of the plasma as predicted theoretically. However, this impurity diffused outwardly when the divertor was turned on. Few impurity particles diffused into the plasma when launched in the scrape-off layer. This optimized bundle divertor meets the engineering constraints of a power producing reactor.

1628 **(DOE/ET/52040—T18) Stochastic modelling of fusion-product transport and thermalization with nuclear elastic scattering.** Deveaux, J.C. (Illinois Univ., Urbana (USA)). 1983. Contract AC02-76ET52040. 213p. NTIS, PC A10/MF A01. Order Number DE84001524.

Portions are illegible in microfiche products; Thesis.

Monte Carlo methods are developed to model fusion-product (fp) transport and thermalization with both Rutherford scattering and nuclear elastic scattering (NES) in high-temperature (T/sub i/, T/sub e-/ > 50 keV), advanced-fuel (e.g. Cat-D, D-^{3}He) plasmas. A discrete-event model is used to superimpose NES collisions on a Rutherford scattering model that contains the Spitzer coefficients of drag, velocity diffusion (VD), and pith-angle scattering (PAS). The effects of NES on fp transport and thermalization are investigated for advanced-fuel, Field-Reversed Mirror (FRM) plasmas that have a significant Hamiltonian-canonical angular momentum (H-Pθ) space loss cone which scales with the characteristic size (S identical with R/sub HV//3p/sub i/) and applied vacuum magnetic field (B_0).

1629 **(DOE/ET/53001—5) Applications of hybrid numerical-simulation methods to magnetic-confinement systems. Annual technical report, 1 January 1983-31 December 1983.** Morse, R.L. (Arizona Univ., Tucson (USA). Dept. of Nuclear and Energy Engineering). 1983. Contract AC02-77ET53001. 41p. NTIS, PC A03/MF A01. Order Number DE84001840.

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During this contract period we started out to extend and refine our kinetic modeling of wall plasma near divertors or limiters to include, in particular, prediction of sputtering rates. As a result of seeing data indicating edge temperatures below the kinetic range, and some questions about previous fluid modeling, we also began our own fluid modeling. One of the fluid results which we found interesting is a class of solutions which are not stationary but exhibit periodic relaxation oscillations. We speculate about a possible relationship between these solutions and the H-mode. Also during this period we have done calculations of Argon radiation power at typical Tolemak densities and over a wide range of temperatures. The results of this work may have interesting implications for main plasma energy containment and ignition as well as for edge plasma control.

1630 **(DOE/ET/53048—T2) Collision cross sections and equilibrium fractions of ions and atoms in metal-vapor targets. Project progress report, May 1, 1981-April 30, 1983.** Morgan, T.J. (Wesleyan Univ., Middletown, CT (USA)). Sep 1983. Contract AC02-76ET53048. 8p. NTIS, PC A02/MF A01. Order Number DE84001130.

The objective of this progrm during the period covered in this report is to measure atomic collision cross sections and equilibrium fractions of ions and atoms in metal-vapor targets. The goal is to obtain experimental information on atomic collision processes of importance to the Magnetic Fusion Energy Program. In particular, (1) in connection with the development of negative ion sources, we have completed our studies of D^- formation in alkaline-earth metal-vapor targets; (2) in connection with lithium-beam probing of the alpha particle distribution in plasmas, we have completed our studies of the relevant cross sections; and (3) in connection with possible neutral helium injection into plasmas, we have measured the He^- fraction in two metal-vapor targets. Finally, we have completed all experimental modifications required in order to pursue our studies of highly excited state formation in H^- stripping.

1631 **(DOE/ET/53088—105) Nonlinear interaction of toroidicity induced drift modes.** Similon, P.L.; Diamond, P.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Sep 1983. Contract FG05-80ET53088. 44p. (IFSR—105). NTIS, PC A03/MF A01. Order Number DE84001562.

Drift modes in toroidal geometry are destabilized by trapped electron inverse dissipation and evolve to a nonlinearly saturated state. Using renormalized one-point turbulence theory for the nonlinear gyrokinetic equation in the ballooning representation, it is shown that ion Compton scattering is an effective saturation mechanism. Ion Compton scattering transfers wave energy from short to long perpendicular wavelength, where it is absorbed by ion resonance with extended, linearly stable, long wavelength modes. The fluctuation spectrum and fluctuation levels are calculated using the condition of nonlinear saturation. Transport coefficients and energy confinement time scalings are determined for several regimes. Specifically, the predicted confinement time density scaling for an Ohmically heated discharge increases from n/sup 3/8/ in the collisionless regime to n/sup 9/8/ in the dissipative trapped electron regime.

1632 **(DOE/ET/53088—108) Effects of compressibility on the resistive ballooning mode.** Hender, T.C.; Carreras, B.A.; Cooper, W.A.; Holmes, J.A.; Diamond, P.H.; Similon, P.L. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Oak Ridge National Lab., TN (USA); Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Sep 1983. Contract FG05-80ET53088;W-7405-ENG-26. 37p. (IFSR—108). NTIS, PC A03/MF A01. Order Number DE84001558.

The linear stability of the resistive ballooning mode, as described by the resistive MHD model, is investigated both analytically and numerically. When the pressure evolution is approximated by fluid convection (reduced MHD model), an instability driven by geodesic curvature, with a growth rate $\gamma \sim$ eta/sup 1/3/β/sub rho//sup 2/3/, is found. For conditions relevant to the Impurity Study Experiment (ISX-B), it is shown that for modest poloidal beta (β/sub rho/ $\simeq$ 1), high current, and relatively high temperatures, compressibility has a significant stabilizing influence, relative to the pressure convection model, for low toroidal mode number modes. However, at high β/sub rho/ ($\geqq$ 2), low current, and lower temperatures, compressibility has much less effect.

1633 **(DOE/ET/53088—111) Drift waves in rotating plasmas.** Horton, W.; Liu, J. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Sep 1983. Contract FG05-80ET53088. 39p. (IFSR—111). NTIS, PC A03/MF A01. Order Number DE84000391.

The stability of the electron drift wave is investigated in the presence of E x B plasma rotation typical of the central cell plasma in tandem mirrors. It is shown that a rotationally-driven drift wave may occur at low azimuthal mode numbers. Conditions for rotational instabilities are derived. Quasilinear formulas are given for the anomalous transport associated with the unstable fluctuations.

1634 **(EUR-CEA-FC—1172) Study of low-frequency density fluctuations in the PETULA B tokamak by sub-millimetre laser interferometry.** Guharay, S.K. (Societe Generale d'Entreprises (SGE), 75 - Paris (France)). Jan 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704270.

A submillimetre laser interferometry technique with a CO_2 - pumped CH_3I laser at 447 μm wavelength is employed for the first time to study low-frequency (up to 100 kHz) electron-density fluctuations in a tokamak. Digitally implemented spectral analysis method is used to investigate the characteristics of fluctuations in both low-density (approximately 1.5 x 10^{13}cm(s)) and high-density (approximately 6-7 x $10^{13}cm^{-3}$) discharges in the absence as well as in the presence of the lower hybrid waves. It is found that the lower-hybrid wave influences the spectrum significantly in a manner to stabilize the coherent waves excited during the ohmic heating phase. The spectral index n of the fluctuations, corresponding to the relation P approximately fsup(-n) in the power spectrum, is estimated during the ohmic heating period to be about 3.5 in the low-density case, while it is approximately 5 in the high-density regime.

1635 **(EUR-CEA-FC—1174) Evolution of repetitive explosive instabilities in space and time.** Wilhelmsson, Hans. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Feb 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704271.

A nonlinear rate equation describing nonlinear, explosive type interaction of waves in plasmas is studied, assuming that amplitude saturation occurs due to nonlinear frequency shifts. Emphasis is put on the space dependence of the solution caused by the assumption of a given initial amplitude distribution in space. An analysis is given of the problem of repetitive peaks governed by the nonlinear rate equation for the time development of the amplitudes of plasma waves and by a Lorentzian shape distribution of the initial amplitudes. We find for the one-dimensional case that the peaks developed by explosive instability move in the direction of lower initial amplitude values, and we determine the speed and the repetition rate of the peaks. The possible forms of equilibria for the nonlinear rate equation in the explosive case are also studied, including, in addition to the quadratic nonlinearity, diffusion and linear damping effects. A solution to the nonlinear rate equation including diffusion is also given for the case where the quadratic nonlinearity represents recombination.

1636 **(GA-A—17276) Numerical study of electromagnetic fluid turbulence.** Waltz, R.E. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1983. Contract AT03-76ET51011. 49p. (CONF-831105—1). NTIS, PC A03/MF A01. Order Number DE84002388.

From Meeting of the Plasma Physics Division of the American Physical Society; Los Angeles, CA, USA (7 Nov 1983).

Nonlinear two fluid equations for the time evolution of the perturbed electrostatic potential, density, vector potential, and ion parallel motion are written for a collisional plasma in toroidal geometry. The nonlinear terms arise from the E tilde x B_0 convection and magnetic flutter. Simplified two dimensional mode coupling calculations with a fixed average parallel wave number and curvature drift are performed for a variety of perturbed field combinations. The hot ion effects of cross field viscosity and FLR truncate the spectrum at large wave numbers. Stationary turbulent states of the collisional drift or resistive interchange mode for $\beta = 0$ and the resistive ballooning mode for $0 < \beta < \beta$/sub crit/ are obtained, and the associated E tilde x B_0 and magnetic flutter transport coefficients are calculated. The results are summarized by comparison to simple scaling laws (e.g., n tilde/n_0 ~ 1/k/sub perpendicular/L/sub n/, B tilde/sub perpendicular//B_0 ~ β n tilde/n_0, D/sub E/ ~ γ/k/sub perpendicular/^{2}).

1637 **(GTFR—43) Effects of neutral beam injection on impurity transport in tokamaks.** Stacey, W.M. Jr.; Sigmar, D.J. (Georgia Inst. of Tech., Atlanta (USA); Oak Ridge National Lab., TN (USA)). Sep 1983. Contract AS05-78ET52025. 36p. NTIS, PC A03/MF A01. Order Number DE84001857.

A self-consistent theory is presented for particle flows in the flux surface, radial particle fluxes and the radial electric field in a tokamak. The effects of beam-impurity momentum exchange, radial transfer of toroidal momentum, and the poloidal variation in density and potential which ensue when v/sub phi/ ≃ v/sub th/ are treated - the interaction among these effects is non-linear. Model problem predictions based on the theory indicate enhanced inward impurity transport with strong counter-injection and outward impurity transport with strong co-injection of neutral beams.

1638 **(INPE—2093) Existence condition of the relativistic ion-acoustic soliton in plasma.** Chian, A.C.-L. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1981. 6p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704272.

Stationary solutions which descrite longitudinal waves in a hot ion-electron plasma, taking in account the relativistic effect of the particle dynamics, are investigated. The solution of the problem can be reduced to two equations related with energy-momentum conservation of the system. Particular attention to the existence condition of the solitary wave solution is given. It is shown that the Langmuir mode (Te=Ti) only admits infinite train-like wave solutions, the existence of solitary-like wave solutions being not possible. On the other hand, in the case of hot electrons and cold ions, an appropriate choice of the boundary conditions produces localized wave solutions, which describe relativistic ion-acoustic solitons.

1639 **(IPP—III/78) Variation of the particle confinement during neutral injection into ASDEX divertor plasmas.** Wagner, F.; Behringer, K.; Campbell, D.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Kornherr, M.; Mueller, E.R.; Rapp, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1982. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE83751316.

With neutral injection into ASDEX divertor plasmas the line average density generally decreases. Evidence is presented that the reduction in plasma content is partly caused by a reduction in particle confinement. The reduction in confinement affects the outer plasma zones first, and frequently, in conjunction with a sawtooth instability, impairs the plasma center too. The overall reduction in particle confinement is not caused by beam effects alone but appears to be correlated with profile changes of the heated plasma. The deterioration of the particle confinement does not seem to be an inevitable occurrence. There exists an operational regime where the density increases during the neutral injection pulse after first decreasing in the usual manner. Under these circumstances the density increase leads to high βsub(p) values of about 1.55 to 1.75 and a threefold enhanced neutron flux. The high βsub(p)-phase is periodically interrupted by gross instabilities in the outer plasma zones which cause sudden βsub(p)-reductions.

1640 **(ITF—82-67-R) Space correlations of charged particles in bounded plasma systems.** Usenko, A.S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1982. 60p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE83704273.

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Simultaneous correlation functions for a plasma layer, cylinder and sphere have been obtained. Analytical and numerical investigations into the behaviour of these distributions depending on the

position of charged particles, dielectric constant of environment and system dimensions have been carried on in detail. Effect of plasma system geometry on spatial correlations of charged particles has been studied. The results obtained permit to judge qualitative and quantitative differences in the found regularities both from the Coulomb and Debye distributions, on one side, and analogous results for semi-confined plasma, on the other side, and therefore to judge the necessity of consideration of the second boundary (for layer) or system confinement in the transverse direction (for cylinder).

1641 **(LA—9785) Filamentation instability associated with a relativistic beam and a finite-temperature, collisional plasma.** Thode, L.E.; Cary, J.R.; Jones, M.E.; Mostrom, M.A.; Newberger, B.S. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01. Order Number DE84002303.

An unmagnetized, homogeneous, ordinary-mode interaction associated with a scattered relativistic electron beam and a finite-temperature, collisional plasma is investigated. Both isotropic plasma temperature and collisions are destabilizing. Depending upon plasma temperature, collisions can either decrease or increase the growth rate. The growth rate is only weakly dependent upon the form of the beam distribution function, but the unstable spectrum is limited to shorter wave numbers for the scattered relativistic distribution. With a finite collision rate and under conditions of good current neutralization, only a finite boundary can suppress the instability. Numerical solutions indicate the filamentation instability is probably not responsible for observed beam disturbances in the 20-MeV PHERMEX beam-propagation experiments.

1642 **(MLM—3097) Calculation of charged particle densities in pure tritium gas.** McConville, G.T. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 14 Oct 1983. Contract AC04-76DP00053. 7p. NTIS, PC A02/MF A01. Order Number DE84001887.

Tritium gas at room temperature is a mixture of T_2, T_2/sup */ (excited states), T_2/sup */, T_3^+, T^-, and electrons. The electrons are divided into two groups: fast electrons causing stripping reactions and thermal electrons. From a set of steady state equations and reaction rates determined from H_2 and D_2 data, the concentrations of the above charged species are determined. It was found that of the order of five T_2 molecules in 10^8 in a vibrational excited state of nu = 3 or 4 can produce the ratio of T^- to e^- of the order of 100 observed by Souers, et al.

1643 **(N—8325561) Research on turbulence in plasma.** (College of William and Mary, Williamsburg, VA (USA)). 1982. 15p. (NASA-CR—170260). NTIS, PC A02/MF A01.

The plasma turbulence research program at William and Mary is discussed. The search has been less for phenomena to explain than for nontrivial magnetohydrodynamic processes in the fully turbulent domain that can be understood. Two examples are used to illustrate this: (1) development of anisotropy in the presence of a strong do magnetic field and (2) the decay of an MHD turbulent field to a dynamically aligned state with velocity field and magnetic fields parallel or antiparallel.

1644 **(ORNL/TM—8833) Equilibrium studies for low-aspect-ratio torsatrons.** Garcia, L.; Carreras, B.A.; Harris, J.H.; Hicks, H.R.; Lynch, V.E. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01. Order Number DE84002264.

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Three-dimensional MHD equilibrium studies have been done for low aspect ratio torsatrons. These studies cover continuous-coil and modular torsatrons. The equilibrium properties improve with aspect ratio, as is expected. The role played by the vertical field has also been investigated. Outward shifts cause the flux surfaces to deteriorate. Inward shifts improve the flux surfaces at the expense of stability properties.

1645 **(ORNL/TM—8868) Indirect processes in electron-ion scattering.** Bottcher, C.; Griffin, D.C.; Pindzola, M.S.; Phaneuf, R.A. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01. Order Number DE84002381.

A summary is given of an informal workshop held at Oak Ridge National Laboratory on June 22-23, 1983, in which the current status of theoretical calculations of indirect processes in electron-ion scattering was reviewed. Processes of particular interest in astrophysical and fusion plasmas were emphasized. Topics discussed include atomic structure effects, electron-impact ionization, and dielectronic recombination.

1646 **(ORNL/TM—8883) Radial structure of curvature-driven instabilities in a hot-electron plasma.** Spong, D.A.; Berk, H.L.; Van Dam, J.W. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01. Order Number DE84002256.

A nonlocal analysis of curvature-driven instabilities for a hot electron ring interacting with a warm background plasma has been made. We have examined four different instability modes characteristic of hot electron plasmas: the high-frequency hot electron interchange (at frequencies larger than the ion cyclotron frequency), the compressional Alfven instability, the interacting background pressure-driven interchange, and the conventional hot electron interchange (at frequencies below the ion cyclotron frequency). We have also examined the decoupling condition between core and hot electron plasmas as it influences the background and hot electron interchange stability requirements. The assumed equilibrium plasma profiles and resulting radial mode structure differ somewhat from those used in previous local analytic estimates; however, when the analysis is calibrated to the appropriate effective radial wavelength of the nonlocal calculation, reasonable agreement is obtained. Comparison with recent experimental measurements indicates that certain of these modes may play a role in establishing operating boundaries for the ELMO Bumpy Torus-Scale (EBT-S) experiment.

1647 **(PPPL—2033) Quasilinear theory of the ordinary-mode electron-cyclotron resonance in plasmas.** Arunasalam, V.; Efthimion, P.C.; Hosea, J.C.; Hsuan, H.; Taylor, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1983. Contract AC02-76CH03073. 15p. NTIS, PC A02/MF A01. Order Number DE84002361.

A coupled set of equations, one describing the time evolution of the ordinary-mode wave energy and the other describing the time evolution of the electron distribution function is presented. The wave damping is mainly determined by T/sub parallel/ while the radiative equilibrium is mainly an equipartition with T/sub perpendicular/. The time rate of change of T/sub perpendicular/, T/sub parallel/, particle (N_o), and current (J/sub parellel/) densities are examined for finite k/sub parallel/ electron-cyclotron-resonance heating of plasmas.

1648 **(PPPL—2039) Review of the experimental papers at the IAEA conference on noninductive current drive, Culham, 1983.** Motley, R.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1983. Contract AC02-76CH03073. 19p. NTIS, PC A02/MF A01. Order Number DE84002363.

Three types of noninductive current drive experiments have been reported at this conference: (1) neutral beam (2) rf current drive, and (3) relativistic electron beams (REB). If we compare the effort to develop current drive to a horse race, the neutral beam horse was first out of the gates, but it quickly found greener pastures (heating) and has dropped temporarily out of the race. The lower hybrid horse now has a big lead at the first furlong (200 m), but the bulk of the race remains to be run. The fast wave and REB horses have yet to get up speed.

1649 **(PPPL—2043) Neutral transport in the ALT-I limiter.** Boley, C.D.; Heifetz, D.B.; Post, D.E.; Malinowski, M.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC02-76CH03073. 22p. NTIS, PC A02/MF A01. Order Number DE84002360.

The behavior of neutral atoms and molecules in the TEXTOR pump limiter ALT-I has been investigated with the aid of the 2-D Monte Carlo neutral transport code DEGAS. The code incorporates the full set of relevant collision processes (atomic and molecular), and it has a standard wall model which includes fast-neutral reflection and molecular desorption. The limiter was modeled with a 2-D geometry, which included corrections for 3-D effects. Among the quantities predicted by the code which are directly relevant to experiment include the neutral pressure within the plenum and along the duct leading into the plenum, the gettering rates, and the heat flux to the walls of the duct. These have been calculated for a variety of plasma parameters in the inlet, and the behavior with respect to variations of the duct widths has been studied. Because of the presence of the long duct separating the entrance chamber from the plenum, a high probability of ionization generally results, suggesting that a calculation allowing the plasma to adjust to the neutral sources might show a large amount of recycling.

1650 **(PPPL—2044) Excitation of internal kink modes by trapped energetic beam ions.** Chen, L.; White, R.B.; Rosenbluth, M.N. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Texas Univ., Austin (USA). Inst. for Fusion Studies). Oct 1983. Contract AC02-76CH03073. 16p. NTIS, PC A02/MF A01. Order Number DE84002364.

Energetic trapped particles are shown to have a destabilizing effect on the internal kink mode in tokamaks. The plasma pressure threshold for the mode is lowered by the particles. The growth rate is near the ideal magnetohydrodynamic value, but the frequency is comparable to the trapped particle precission frequency. A model for the instability cycle gives stability properties, associated particle losses, and neutron emissivity consistent with the fishbone events observed in PDX.

1651 **(PPPL—2047) Enhancement of the neutral-beam stopping cross section in fusion plasmas due to multistep collision processes.** Boley, C.D.; Janev, R.K.; Post, D.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1983. Contract AC02-76CH03073. 13p. NTIS, PC A02/MF A01. Order Number DE84002362.

Multistep processes involving excited atomic states are found to produce a substantial increase in the stopping cross section for a neutral hydrogen beam injected into a plasma, and thus to reduce the beam penetration. For typical plasma and beam parameters of current large tokamak experiments, the stopping cross-sectional enhancement is found to vary from 25% to 50% depending on the beam energy, plasma density, and impurity level. For neutral hydrogen beams with energies $\geq$ 500 keV, envisioned in tokamak amd mirror reactor designs, the enhancement can be as large as 80 to 90%.

1652 **(SAI—83-1122/PRI-69) Azimuthal ambipolar potential variations and tandem mirror transport.** Lee, X.S.; Myra, J.R.; Catto, P.J. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Oct 1983. Contract AC03-76ET53057. 28p. NTIS, PC A03/MF A01. Order Number DE84002655.

Azimuthal ambipolar potential variations are induced by the magnetic drifts in a quadrupole tandem mirror. Consequently, radial E x B drifts occur and contribute along with the magnetic drifts to the total radial flux in a collisional plasma. This effect is studied self-consistently in the resonant-plateau regime assuming Maxwell-Boltzmann electrons along the field lines. A general form exhibiting the contribution of the E x B drifts to the flux is obtained and shown, in general, to be significant. In the square well limit a particularly transparent form results which illustrates the role of dielectric shielding. When the azimuthal E x B drift and the azimuthal electron diamagnetic drift are equal and in opposite directions, the shielding becomes small and a large induced ambipolar contribution to the flux can occur.

1653 **(SAND—83-1673) Accuracy of radiative-recombination rates calculated with Seaton's approximation for Ne-like ions.** McGuire, E.J. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01. Order Number DE84002087.

Radiative recombination rates using Seaton's approximate hydrogenic photoionization cross-section in a detailed balance expression are compared with rates obtained from explicit cross-section calculations for Ne-like ions with nuclear Z between 22 and 44. While Seaton's approximation significantly underestimates cross-sections for low l sublevels and overestimates the cross-section for high l sublevels, the two sets of radiative recombination rates agree to better than a factor of 2 for the Z and temperature range studied here. This good agreement in rates occurs because the rates are dominated by the near-threshold cross-section where Seaton's values are in good agreement ($\approx$ 25%) with the explicit calculations.

1654 **Use of electric probes in silane radio frequency discharges.** Mosburg, E.R. Jr.; Kerns, R.C.; Abelson, J.R. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **54**: No. 9, 4916-4927(Sep 1983). Contract AC02-77CH00178.

The use of electrostatic probe techniques for measurement of the electron temperature kT/sub e/ and the electron density n/sub e/ in pure and BF_3 doped silane radio frequency (13.56 MHz) discharges is demonstrated to be feasible even though amorphous silicon is being deposited on the probe surfaces. The required conductivity of such deposited silicon surface layers is examined and compared with the measured photoconductivity and thermally induced conductivity of amorphous silicon. An equation is derived for the double probe current—voltage (I—V) curve which includes the first order effect of ac fields and can be used to determine the electron density. During typical depositions of thin films of amorphous silicon from such discharges, values of kT/sub e/ = 2—2.5 eV and n/sub e/ = (1—1.5) x 10^9 cm^{-3} were obtained. These values are consistent with those obtained by other workers using microwave and optical techniques. In BF_3 doped silane an abrupt step is observed in the Langmuir I—V curves which indicates the presence of a group of fast, anisotropic electrons. In diborane doped silane, probe measurements become unstable and irreproducible. For this reason we investigate a rf probe technique. The advantages and constraints inherent in using this method in our rf discharges are examined and analyzed.

1655 **Laser irradiated gas jet: A spectroscopic experimental and theoretical study.** Lee, R.W.; Matthews, D.L.; Koppel, L.; Busch, G.E.; Charatis, G.; Dunning, M.J.; Mayer, F.J. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **54**: No. 9, 4909-4915(Sep 1983). Contract W-7405-ENG-48;AC08-82DP40152.

We present x-ray spectroscopic measurements of the longitudinal electron density profile and the longitudinal and transverse electron temperature profiles for a laser irradiated gas jet. We attempt to verify our spectroscopic method by laser interferometry and by comparison of inferred quantities to those determined from laser plasma interaction simulations. Because temperature profiles were time dependent, we used a theoretical time dependent radiation transport code to analyze the data.

1656 **Monte-Carlo simulation of electron properties in rf parallel plate capacitively coupled discharges.** Kushner, M.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Applied Physics;* **54**: No. 9, 4958-4965(Sep 1983). Contract W-7405-ENG-48.

Electron properties in a parallel plate capacitively coupled rf discharge are studied with results from a Monte-Carlo simulation. Time averaged, spatially dependent electron distributions are computed by integrating, in time, electron trajectories as a function of position while oscillating the applied electric field at rf frequencies. The dc component of the sheath potential is solved for in a self-consistent manner during the simulation. For conditions where the secondary emission coefficient for electrons from the electrodes is

large, the electron distribution is spatially differentiated, being dominated by an e-beam component near the electrodes while being nearly in equilibrium with the applied electric field in the body of the plasma. The dc component of the sheath potential is found to be a function of the ratio λ/d, where λ is the electron mean free path and d is the electrode spacing.

1657 **Effects of internal disruptions on impurity transport in tokamaks.** Seguin, F.H.; Petrasso, R.; Marmar, E.S. (American Science and Engineering, Incorporated, Cambridge, Massachusetts 02139). *Physical Review Letters;* **51**: No. 6, 455-458(8 Aug 1983). Contract AC02-77ET53068;AC02-78ET51013.

The effects of diffusion, convection, and internal disruptions on impurity profile evolution in the tokamaks are investigated by use of experimental measurements, numerical simulations, and a new analytic eigenfunction formalism for confinement times and profile shapes. Experimental observations on the Alcator C tokamak show that internal disruptions flatten radial profiles of impurity densities in the plasma core, and theoretical calculations indicate that periodic internal disruptions should significantly decrease impurity confinement times under some circumstances.

1658 **Use of Laue-geometry x-ray diffraction in the spectroscopy of laser plasmas.** Hauer, A. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Optics Letters;* **8**: No. 8, 434-436(Aug 1983).

Laue x-ray crystal diffraction geometry offers a number of advantages for the spectroscopic diagnosis of laser plasmas. Applications of this diffraction configuration, such as absorption spectroscopy, time-resolved spectroscopy, and x-ray polarization measurements, are described.

1659 **Convective instability of a plasma slab in a magnetic field.** Shivamoggi, B.K. (Australian National Univ., Canberra. Dept. of Theoretical Physics); Uberoi, M.S. (Colorado Univ., Boulder (USA)). *Physica Scripta;* **28**: No. 1, 89-91(Jul 1983).

Convective instability of a plasma slab (contained between two metal walls) subject to a longitudinal applied magnetic field is considered. The method of solution is akin to the variational method introduced by Chandrasekhar in 1961. It is found that the plasma is stable for wave-numbers less than a certain value ksub(c).

1660 **Radial transport calculations for tandem mirrors.** Mirin, A.A.; Auerbach, R.H.; Cohen, R.H.; Gilmore, J.M.; Pearlstein, L.D.; Rensink, M.E. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Fusion;* **23**: No. 6, 703-738(Jun 1983).

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The existence of a non-axisymmetric magnetic field in the transition regions between the central cell and end-plugs of a tandem mirror device can lead to significant radial transport of central-cell ions. Self-consistent calculation of the consequences of this non-ambipolar process requires the solution of a highly non-linear charge balance equation for the ambipolar potential. In this paper, radial transport in tandem mirrors is studied, with particular emphasis on the charge balance equation and its consequences. A time-dependent radial transport code is presented. Simulations of the Tandem Mirror Experiment (TMX) are performed. Generally, good agreement between code and experiment is obtained. The phenomenon of quenching of radial transport is analysed and demonstrated numerically.

1661 **Plasma analysis of a tokamak Fusion Engineering Device (FED).** Peng, Y.K.M.; Lyon, J.F.; Attenberger, S.E. (Oak Ridge National Lab., TN (USA)). pp 409-423 of Plasma physics and controlled nuclear fusion research 1982 . Proceedings of the ninth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in Baltimore, 1-8 September 1982. Vol. 1. Vienna, Austria; IAEA (1983). (IAEA-CN—41/E-5).

From 9. international conference on plasma physics and controlled nuclear fusion research; Baltimore, MD (USA) (1-8 Sep 1982).

A wide range of plasma assumptions and scenarios has been examined for the current US tokamak Fusion Engineering Device (FED) concept, which aims at providing a controlled long-pulse (approx. 100 s) burning plasma with an energy amplification $Q>=5$, a fusion power of 180 MW, and a neutron wall load $>=0.4$ MW.m^{-2}. The current FED baseline parameters are R=5.0 m, Bsub(t)=3.6 T, a=1.3 m, b=2.1 m(D-shape), and Isub(p)=5.4 MA with superconducting coils. To enhance the probability of achieving fusion ignition, a limited operating capability of Bsub(t)=4.5 T, Isub(p)=6.5 MA, and a fusion power of 450 MW is incorporated. The FED assumes ion-cyclotron resonance heating at the deuterium second harmonic without precluding neutral beams as an alternate; it includes a pump limiter for particle exhaust with a simplified poloidal divertor as an alternate; and it aims at achieving a plasma $Q>=5$ with ignition as a strong possibility. Advanced performance possibilities of FED based on non-inductive current drive and operations in a low-q disruption-free regime are also discussed.

1662 **Lepton power: future fact or fiction.** Olenick, R.P. (Dallas Univ., Irving, TX (USA). Dept. of Physics). *European Journal of Physics;* **3**: No. 1, 50-56(1982).

Developments in particle physics again raise the question of cold fusion as a practical energy source. Specifically, a heavy lepton injected into a chamber containing light atoms can attract two nuclei to form a bound state. With the heavy lepton as the nucleus of this system, the two nuclei are within the range of the strong force. The probability for quantum mechanical tunnelling of the nuclei through the Coulomb barrier is substantial and the fusion is catalysed by the heavy lepton. In this paper we examine the feasibility of such catalytic fusion by considering the energy of such systems, the formation times, tunnelling probabilities, and the efficiency of catalysis.

1663 **Acquisition, archiving, and analysis of Doublet III diagnostic data on a distributed computer system.** Glad, A.; Henline, P.; McHarg, B.; Drobnis, D.; Karin, S.; Shephard, G. (General Atomic Co., San Diego, CA (USA)). pp 705-710 of Fusion technology 1980. Vol. 2. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

Computer support of a Tokamak fusion experiment for the purpose of data acquisition, analysis, and archiving required handling the large amounts of data generated each shot, and presenting the data for both individual diagnostic experiments and shot summary in a timely and useful manner. A distributed computer system with processing at three levels supports General Atomic's Doublet III Tokamak by providing: (1) acquisition and permanent archiving of all diagnostic data, (2) analysis and control for each physics diagnostic, (3) overall shot summary after each shot, and (4) detailed analysis of current and past shot data.

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REFER ALSO TO CITATION(S) 595, 768, 789, 790, 1009, 1014

1664 **(AD-A—130408/8) Experiments on the dynamics and hydrodynamic instabilities of ablatively accelerated targets. Technical report.** (Mission Research Corp., Alexandria, VA (USA)). Feb 1983. 230p. NTIS, PC A11/MF A01.

Experiments on pressure and velocity of accelerated foils were conducted using the double foil technique or actual laser foil experiments. The x ray tracer technique was investigated to determine if it is suitable to track plasma flow from targets accelerated from high velocities and/or for the study of plasma hydrodynamic instabilities. Plasma calorimeter and ion collectors were used to investigate laser absorption in long density scale length plasmas. Software was developed for investigating the properties of laser interaction with matter.

1665 **(ANL/FPP/TM—176) Coupling between angular deflection and eddy currents in the FELIX plate experiment.** Turner, L.R.; Cuthbertson, J.W. (Argonne National Lab., IL (USA)). Aug 1983. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01. Order Number DE84001509.

For a conducting body experiencing superimposed changing and steady magnetic field, for example a limiter in a tokamak during plasma quench, the induced eddy currents and the deflections resulting from those eddy currents are coupled. Experimental study of these coupled deflections and currents can be performed with the FELIX (Fusion Electromagnetic Induction Experiment) facility nearing completion at ANL. Predictions of the coupling are described, as computed with the code EDDYNET, which has been modified for this purpose. Effects of the coupling will be readily observable experimentally. In the FELIX plate experiment, the coupling between deflection and eddy currents was readily calculated because the rigid-body rotation of the plate is equivalent to a contrarotation of the applied magnetic fields. For a geometry such as a plasma limiter, in which the eddy currents would cause a deformation of the conducting body, an analysis of the coupling between eddy currents and deformation would require a structural-analysis code and an eddy current code to be simultaneously computing from the same mesh.

1666 **(CONF-811040—204) Properties of yttrium sorbers which improve tritium sorption rate from liquid lithium.** Fisher, P.W.; Talbot, J.B.; Clinton, S.D.; Rogers, F.L.; Watson, J.S. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01. Order Number DE84002061.

From 9. symposium on engineering problems of fusion research; Chicago, IL, USA (26 Oct 1981).

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A model, based on solute uptake from a well-mixed solution, has been developed to determine sorber diffusivities from tritium sorption data. Diffusivities from eleven experimental runs, which include five samples of yttrium and two different geometries at two temperatures, have been correlated with surface area and void fraction. Acceptable performance is achieved at 300°C when surface areas are greater than 0.1m²/gm and porosities are greater than 30%. Sorbers which fall in this range have been produced from pelletized yttrium powder.

1667 **(CONF-811040—205) Gyrotron: an ECH system component.** Loring, C.M.; Eason, H.O.; Kimrey, H.D.; White, T.L.; Jory, H.R.; Evans, S.J. (Oak Ridge National Lab., TN (USA); Varian Associates, Inc., Palo Alto, CA (USA)). 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE84001999.

From 9. symposium on engineering problems of fusion research; Chicago, IL, USA (26 Oct 1981).

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The gyrotron, or electron-cyclotron maser, in the form of a gyromonotron, is being developed as a source of millimeter wave energy for fusion plasma heating. The characteristics of this high power, high efficiency electron tube are described in terms of the requirements for the beam power supply system, the mechanical support system, the cooling system, the focusing and tuning magnets, and the waveguide system. Requirements of power level and transmission efficiency dictate the use of oversize waveguide. The implications, both to the user and to the interaction mechanisms in the gyrotron, of the use of oversize waveguide are treated. The effects of variations of various operating parameters upon the gyrotron's power output and stability are also discussed. Data from gyrotron development and system operation are used where appropriate.

1668 **(CONF-830942—51) Steady-state hydrogen transport in solids exposed to fusion-reactor plasmas. Part II. Applications of theory.** Doyle, B.L.; Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 14p. NTIS MF A01. Order Number DE84001646.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

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The previously-developed steady-state theory of plasma-driven H transport through wall membranes is applied to several materials of interest to controlled fusion. The theory is used to predict H isotope inventory, recycle time and permeation rate under nonisothermal conditions and includes the effects of H traps. The materials included in this study were 304 stainless steel, INCONEL, Al, Mo, Cu, W, Ni, Ti, V, Ta, Zr, Be, C, B, and Si.

1669 **(DOE/ER/52083—T1) External wave-launcher study. Final report.** (JAYCOR, Santa Monica, CA (USA)). 30 Jun 1983. Contract AC03-82ER52083. 69p. NTIS, PC A04/MF A01. Order Number DE84001124.

The rationale for liquid dielectrically-loaded external waveguide launchers is discussed. The arguments are strongly indicative that a liquid dielectric-filled waveguide system could be a practical technique for launching ICRH power into a fusion reactor. A detailed summary of the work performed in the study is presented.

1670 **(DOE/ET/51013—50) FED-R2: concept and magnet design of a low-cost FED.** Williams, J.E.C.; Becker, H.; Blackfield, D.; Bobrov, E.; Bromberg, L.; Cohn, D.R.; Diatchenko, N.; LeClaire, R. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Dec 1982. Contract AC02-78ET51013. 169p. (PFC/RR—82-23). NTIS, PC A08/MF A01. Order Number DE84001075.

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High performance resistive magnet technology was used to develop a design for a compact, low cost version of the fusion engineering device FED. We refer to this design as FED-R2, for FED-resistive magnet design 2 to distinguish it from the larger resistive magnet design for FED which uses demountable coils (FED-R1). The main objectives of FED-R2 are: (1) to demonstrate reliable, quasi-steady state (long pulse, high duty factor) operation with Q/sub p/ $\sim$ 5; (2) to demonstrate Q/sub p/ $>$ 5 operation for a limited number of pulses; (3) to provide high neutron flux for irradiation of nuclear test modules with a total area greater tha 20m²; (4) to utilize steady-state RF current drive if this option appears promising. Based upon the costing codes at the Fusion Engineering Design Center and upon TFTR costs, the estimated direct costs of FED-R2 would be on the range 380 to 460M, a factor of about 2 below that of the baseline FED design.

1671 **(DOE/ET/51013—94) System impedance and high-speed transient behavior of the Alcator-C magnet-power-supply system.** Warner, T.H.; Kassakian, J.G. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1983. Contract AC02-78ET51013. 44p. (PFC/RR—83-23). NTIS, PC A03/MF A01. Order Number DE84001597.

The commutation inductance is one of the parameters which determines the voltage regulation, ac bus notch depth, inversion margin angle and converter conduction mode for the TF power supply. It was felt that measuring the actual commutation inductance would provide valuable information on this parameter and a chance to become familiar with the details of the Alcator power supplies. Although initial work indicated that the commutation inductance varied during an Alcator experimental run, the measurements reported here show the inductance to be almost constant. While measuring the commutation inductance, two seemingly unrelated phenomena were observed; lightly damped ringing in the commutation notches and growing oscillations of the alternator voltage envelope. Theoretical models and simulations have been developed to explain the ringing and envelope oscillations. Two possible methods of damping the resonance (and thus eliminating the ringing and envelope oscillation) are proposed and the relative merits of each solution have been outlined.

1672 **(DOE/ET/51013—99) Plasma/neutral gas transport in divertors and limiters.** Gierszewski, P.J. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1983. Contract AC02-78ET51013. 207p. NTIS, PC A10/MF A01. Order Number DE84001594.

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The engineering design of the divertor and first wall region of fusion reactors requires accurate knowledge of the energies and particle fluxes striking these surfaces. Simple calculations indicate

that ~ 10 MW/m² heat fluxes and ~ 1 cm/yr erosion rates are possible, but there remain fundamental physics questions that bear directly on the engineering design. The purpose of this study was to treat hydrogen plasma and neutral gas transport in divertors and pumped limiters in sufficient detail to answer some of the questions as to the actual conditions that will be expected in fusion reactors. This was accomplished in four parts: (1) a review of relevant atomic processes to establish the dominant interactions and their data base; (2) a steady-state coupled O-D model of the plasma core, scrape-off layer and divertor exhaust to determine gross modes of operation and edge conditions; (3) a 1-D kinetic transport model to investigate the case of collisionless divertor exhaust, including non-Maxwellian ions and neutral atoms, highly collisional electrons, and a self-consistent electric field; and (4) a 3-D Monte Carlo treatment of neutral transport to correctly account for geometric effects.

1673 **(HEDL-SA—2883) Fast neutron irradiation results on Li_2O, Li_4SiO_4, Li_2ZrO_3 and $LiAlO_2$.** Hollenberg, G.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1983. Contract AC06-76FF02170. 12p. (CONF-830942—54). NTIS, PC A02/MF A01. Order Number DE84001487.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

Several ceramic solid breeder materials were irradiated in the fast neutron flux of EBR-II to a burnup of 3 x 10^{20} captures/cm³ in the 500°C to 900°C temperature range. Performance data were obtained on structural integrity, lithium transport, pellet swelling, and grain growth. The data provide a basis for more accurately forecasting the feasibility and performance limitations for these materials.

1674 **(HEDL-SA—2896) Factors which determine the swelling rate of austenitic stainless steels.** Garner, F.A.; Wolfer, W.G. (Hanford Engineering Development Lab., Richland, WA (USA); Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 1983. Contract AC06-76FF02170. 7p. (CONF-830942—56). NTIS, PC A02/MF A01. Order Number DE84001474.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

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Once void nucleation subsides, the swelling rate of many austenitic alloys becomes rather insensitive to variables that control the transient regime of swelling. Models are presented which describe the roles of nickel, chromium and silicon in void nucleation. The relative insensitivity of steady-state swelling to temperature, displacement rate and composition is also discussed.

1675 **(HEDL-SA—2910) Analytical approach for projecting material property uncertainties.** Puigh, R.J.; Opperman, E.K.; Wire, G.L.; Nygren, R.E. (Hanford Engineering Development Lab., Richland, WA (USA); IIT Research Inst., Chicago, IL (USA); Argonne National Lab., IL (USA)). Aug 1983. Contract AC06-76FF02170. 17p. (CONF-830942—55). NTIS, PC A02/MF A01. Order Number DE84001469.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

An analytical approach for projecting material properties uncertainties has been developed which can be used to assess the relative merit of materials testing in various neutron environments. This approach provides the designers and program planners with a quantitative estimate of material property uncertainties at fluences higher than the existing data base. These results can then be used to assess the relative merit of a particular materials testing program in a given neutron source. This approach has been applied to the materials testing program in FED/INTOR. The analysis indicated that for austenitic alloys materials testing in FED/INTOR significantly reduce tensile property uncertainties after materials testing corresponding to a first wall loading of 3 MW.yr/m². For swelling, the uncertainty in swelling may not be reduced even if materials testing is performed out to the present design goal for FED/INTOR of 6 MW.yr/m².

1676 **(HEDL-TME—83-27) Reduced activation calculations for the STARFIRE first wall.** Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76FF02170. 75p. NTIS, PC A04/MF A01. Order Number DE84002089.

The activation of 27 elements (Li, Be, B, C, N, O, Mg, Al, Si, P, S, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zr, Nb, Mo, Sn, Hf, Ta, W, and Pb) was calculated for a two-year exposure at the STARFIRE first-wall position. Based on a reasonable extension of current NRC regulations for near-surface land disposal, restrictions on N, Al, Ni, Cu, Nb, Mo, and Pb concentrations in first-wall materials may be required.

1677 **(IAEA-TECDOC—277) Fusion safety.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1983. 179p. (CONF-810352—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84780031.

From International Atomic Energy Agency conference on fusion safety; Vienna, Austria (23 Mar 1981).

Abstracts for each paper were entered into the data base. (MOW)

1678 **(JINR—R-7-82-749) Mass-spectrometric investigation of atomic and molecular ions produced under the action of laser radiation on a solid target.** Arzumanyan, G.M.; Bogdanov, D.D.; Bykovskij, Yu.A.; Rodin, A.M.; Sil'nov, S.M.; Ter-Akop'yan, G.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE83704274.

Portions are illegible in microfiche products7 refs.; 5 figs.; 3 tabs.; Int. J. Mass Spectrom. Ion Phys.

Energy, charge and angular distributions of atomic and molecular ions produced under the action of the nanosecond laser radiation on a solid target are investigated by the mass-spectrometric method. It is shown that a considerable part of single-charged ion component is formed by the ions produced as a result of thermal evaporation and secondary interaction of laser-plasma bunch with a target surface. It is established that molecular ions are completely produced due to secondary interaction of laser-plasma bunch with a target surface.

1679 **(LA—9774-MS) Limiter study.** Downing, J.N.; Gordon, R.A.; Thomas, K.S.; Watt, R.G. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01. Order Number DE84002288.

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Studies of energy deposition on a mushroom-shaped limiter have been performed on ZT-40M. Total energy deposition, estimated power deposition per unit area, the effects of gas puffing and vertical and error field application, and approximate time histories of the extent of the impact area are presented for two different current levels (120 and 190 kA), protrusions into the body of the plasma (+2 - +12 mm from the wall) and limiter materials. Photographs of a bare graphite and TiC-coated graphite limiter before and after exposure to the plasma are shown. Massive spallation of the TiC-coated limiter is observed at the higher current level. Spallation occurs during the discharge and after termination. The degree of spallation is dependent on the current level. The average power deposition on the limiter over the discharge is estimated to be ≦ 1 MW.

1680 **(LA-UR—83-2628) Advanced nuclear data for radiation-damage calculations.** MacFarlane, R.E.; Foster, D.G. Jr. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 7p. (CONF-830942—50). NTIS, PC A02/MF A01. Order Number DE84001343.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

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Accurate calculations of atomic displacement damage in materials exposed to neutrons require detailed spectra for primary recoil nuclei. Such data are not available from direct experimental measurements. Moreover, they cannot always be computed accu-

rately starting from evaluated nuclear data libraries such as ENDF/B-V that were developed primarily for neutron transport applications, because these libraries lack detailed energy-and-angle distributions for outgoing charged particles. Fortunately, a new generation of nuclear model codes is now available that can be used to fill in the missing spectra. One example is the preequilibrium statistical-model code GNASH. For heating and damage applications, a supplementary code called RECOIL has been developed. RECOIL uses detailed reaction data from GNASH, together with angular distributions based on Kalbach-Mann systematics to compute the energy and angle distributions of recoil nuclei. The energy-angle distributions for recoil nuclei and outgoing particles are written out in the new ENDF/B File 6 format. The result is a complete set of nuclear data that can be used to calculate displacement-energy production, heat production, gas production, transmutation, and activation. Sample results for iron are given and compared to the results of conventional damage models such as those used in NJOY.

1681 **(LA-UR—83-2694) Description and performance of uranium beds used to getter tritium-deuterium at the Tritium Systems Test Assembly.** Walthers, C.R. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 5p. (CONF-831171—8). NTIS, PC A02/MF A01. Order Number DE84001305.

From American Vacuum Society meeting; Boston, MA, USA (1 Nov 1983).

The Tritium Systems Test Assembly, (TSTA), a full size simulation of the fuel loop for a fusion reactor, will circulate 360 g mol/day (1800 g) of DT and will have an inventory of 150 g of tritium. During shutdown, a safe storage system for hydrogen isotopes, primarily DT, is needed. Uranium reacts readily with hydrogen, deuterium or tritium at room temperatures to form $U(H,D,T)_3$ having a dissociation pressure of approximately 10^{-4} torr. Upon heating to 720 K, the isotopes will desorb at pressures of one to two atmospheres. Uranium beds were selected as a means for long-term storage of the fuel loop inventory.

1682 **(LA-UR—83-2972) Study of limiter damage in a magnetic-field error region of the ZT-40M experiment.** Makowitz, H. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 6p. (CONF-830942—57). NTIS, PC A02/MF A01. Order Number DE84001711.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

A study has been initiated of material plasma interactions on the ZT-40M, Reversed Field Pinch (RFP) plasma physics confinement experiment at Los Alamos National Laboratory. Observations of the evaporation and cracking to TiC coatings, initially placed on an AXF-5Q Graphite mushroom limiter, installed in a high field error region (e.g. an experimental vacuum vessel/liner port) were investigated. A parametric study was performed of the thermal and stress behavior of the limiter and coating materials undergoing plasma material heat exchange processes, in order to infer the magnitude of heat flux necessary to explain the observed material damage. In addition the vacuum (liner) wall material behavior was studied parametrically using the same heat flux values as the limiter study. A one-dimensional conduction model was used with applied heat and radiation boundary conditions, for predicting temperature distributions in space and time, where the thermal stress was calculated using a restrained in bending only plate model. Wall loadings corresponding to first wall, limiter energy fluxes ranging between 1 x 10^2 W/cm^2 and 1 x 10^5 W/cm^2 were used as parameters with plasma material interaction times (tau/sub QO) between 0.5 ms and 10 ms. Short plasma energy deposition time (tau/sub QO/ $>$ 10 ms) spacial and time histories of temperature and stress were calculated for SS-304, Inconel-625, TiC and AXF -5Q Graphite materials.

1683 **(LBL-PUB—464) National negative-ion-based neutral-beam development plan.** Cooper, W.S.; Pyle, R.V. (eds.). (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 37p. NTIS, PC A03/MF A01. Order Number DE84001815.

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The plan covers facilities required, program milestones, and decision points. It includes identification of applications, experiments, theoretical research areas, development of specific technologies and reactor development and demonstration facilities required to bring about the successful application of negative-ion-based neutral beams. Particular emphasis is placed on those activities leading to use on existing plasma confinement experiments or their upgrades.

1684 **(ORNL/TM—8767) Diamagnetic measurements on ISX-B: method and results.** Neilson, G.H. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01. Order Number DE84002267.

A diamagnetic loop is used on the ISX-B tokamak to measure the change in toroidal magnetic flux, σ phi, caused by finite plasma current and perpendicular pressure. From this measurement, the perpendicular poloidal beta β/sub I perpendicular to/ is determined. The principal difficulty encountered is in identifying and making corrections for various noise components which appear in the measured flux. These result from coupling between the measuring loops and the toroidal and poloidal field windings, both directly and through currents induced in the vacuum vessel and coils themselves. An analysis of these couplings is made and techniques for correcting them developed. Results from the diamagnetic measurement, employing some of these correction techniques, are presented and compared with other data. The obtained values of β/sub I perpendicular to/ agree with those obtained from the equilibrium magnetic analysis (β/sub IΔ/) in ohmically heated plasmas, indicating no anisotropy. However, with 0.3 to 2.0 MW of tangential neutral beam injection, β/sub IΔ/ is consistently greater than β/sub I perpendicular to/ and qualitatively consistent with the formation of an anisotropic ion velocity distribution and with toroidal rotation. Quantitatively, the difference between β/sub IΔ/ and β/sub I perpendicular to/ is more than can be accounted for on the basis of the usual classical fast ion calculations and spectroscopic rotation measurements.

1685 **(PPPL—2040) SPARK Version One: reference manual.** Weissenburger, D.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1983. Contract AC02-76CH03073. 229p. NTIS, PC A11/MF A01. Order Number DE84001673.

SPARK is a library of FORTRAN computer codes which is used to analyze electrical eddy-current distributions. Version One of SPARK is designed to calculate eddy currents flowing on conducting surfaces where current flow is assumed zero in the direction normal to the surface. Surfaces may vary in resistivity and/or thickness and may include holes. Version One can find a transient solution series in time, a purely resistive solution, or a purely inductive solution. A principal feature of SPARK is the calculation of forces, which result from the interaction of the eddy currents with the primary magnetic field, in a form which is compatible with existing structural analysis codes.

1686 **(RL—83-019, pp 63-70) FELIX program of experiments and code development.** Turner, L.R. (Argonne National Lab., IL (USA)). Jan 1983. NTIS (US Sales Only), PC A02/MF A01. (CONF-8204143—).

From 2. Eddy current seminar; Chilton, UK (27 Apr 1982).

An experimental program and test bed called FELIX (Fusion Electromagnetic Induction Experiment) which is under construction at Argonne National Laboratory is described. The facility includes the following facilities; (a) a sizable constant field, analogous to a tokamak toroidal field or the confining field of a mirror reactor, (b) a pulsed field with a sizable rate of change, analogous to a pulsed poloidal field or to the changing field of a plasma disruption, perpendicular to the constant field, and (c) a sufficiently large volume to assure that large, complex test pieces can be tested, and that the forces, torques, currents, and field distortions which are developed are large enough to be measured accurately. The development of the necessary computer codes and the experimental program are examined.

1687 **(RL—83-019) Eddy current seminar. 22-29 April 1982.** Biddlecombe, C.S. (ed.). (Science and Engineering Research Council, Chilton (UK). Rutherford Appleton Lab.). Jan 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84780035.

Abstracts were entered into the data base for each paper. (MOW)

1688 **(UCID—19659-Rev.1) Normal-zone detectors for the MFTF-B coils. Revision 1.** Owen, E.W.; Shimer, D.W. (Lawrence Livermore National Lab., CA (USA)). 10 Oct 1983. Contract W-7405-ENG-48. 96p. NTIS, PC A05/MF A01. Order Number DE84001667.

In order to protect a set of inductively coupled superconducting magnets, it is necessary to locate and measure normal zone voltages that are small compared with the mutual and self-induced voltages. The method described in this report uses two sets of voltage measurements to locate and measure one or more normal zones in any number of coupled coils. One set of voltages is the outputs of bridges that balance out the self-induced voltages. The other set of voltages can be the voltages across the coils, although alternatives are possible. The two sets of equations form a single combined set of equations. Each normal zone location or combination of normal zones has a set of these combined equations associated with it. It is demonstrated that the normal zone can be located and the correct set chosen, allowing determination of the size of the normal zone. Only a few operations take place in a working detector: multiplication of a constant, addition, and simple decision-making. In many cases the detector for each coil, although weakly linked to the other detectors, can be considered to be independent. An example of the detector design is given for four coils with realistic parameters. The effect on accuracy of changes in the system parameters is discussed.

1689 **(UCID—19872) Initial TMX-U thermal-barrier experiments.** Simonen, T.C.; Allen, S.L.; Berzins, L.; Carter, M.; Casper, T.A.; Clauser, J.F.; Clower, C.A.; Coensgen, F.H.; Correll, D.L.; Cummins, W.F. (Lawrence Livermore National Lab., CA (USA)). 5 Oct 1983. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01. Order Number DE84002018.

This paper describes results from the initial thermal barrier experiments in the Tandem Mirror Experiment-Upgrade (TMX-U). Strong end plugging has been produced using a combination of ECRH gyrotrons with sloshing ion beam injection. Plugging has been achieved with a central cell higher than that of the end plugs. In these low-density central cell experiments (7×10^{11} cm^{-3}) the axial losses (tau/sub parallel to/ = 20 to 80 ms) are smaller than the radial losses (tau/sub perpendicular to/ = 4 to 8 ms). Although no direct measurements are yet available to determine if a thermal barrier potential dip is generated, these experiments support many theoretical features of the thermal barrier concept.

1690 **(UCRL—52000-83-8) Energy and technology review.** (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01. Order Number DE84000988.

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Topics covered include: development of a new sensor for rapid airborne measurements of carbon dioxide exchange rates in regions as diverse as the tropics and the arctic; design of extremely reliable high-current pulse compressors capable of generating continuous, 50 ns, 250 kW pulses at increasingly higher repetition rates exceeding 1 kHz; and developments in the tandem-mirror concept of magnetic confinement fusion, thermal barriers and axisymmetric mirror cells. (GHT)

1691 **(UCRL—53179-82) Fire-protection research for DOE facilities: FY 82 year-end report.** Hasegawa, H.K.; Alvares, N.J.; Lipska-Quinn, A.E.; Beason, D.G.; Priante, S.J.; Foote, K.L. (Lawrence Livermore National Lab., CA (USA)). 2 Sep 1983. Contract W-7405-ENG-48. 87p. NTIS, PC A05/MF A01. Order Number DE84001683.

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We summarize our research in FY 82 for the DOE-sponsored project, Fire Protection Research for DOE Facilities. This research program was initiated in 1977 to advance fire-protection strategies for energy technology facilities to keep abreast of the unique fire problems that develop along with energy technology research. Since 1977, the program has broadened its original scope, as reflected in previous year-end reports. We are developing an analytical methodology through detailed study of fusion energy experiments at Lawrence Livermore National Laboratory (LLNL). Using these experiments as models for methodology development, we are concurrently advancing three major task areas: (1) the identification of fire hazards unique to current fusion energy facilities; (2) the evaluation of accepted fire-management measures to meet and negate hazards; and (3) the performance of unique research into problem areas we have identified to provide input into analytical fire-growth and damage-assessment models.

1692 **(UCRL—88970) Measuring the neutron energy spectrum of laser-fusion targets with CR-39.** Lane, S.M. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1983. Contract W-7405-ENG-48. 12p. (CONF-830969—2). NTIS, PC A02/MF A01. Order Number DE84001422.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

We are developing a detector capable of measuring the neutron energy spectrum from a laser fusion target containing DT fuel. From such a spectrum the compressed areal density of the DT can be inferred by observing the fraction of 14.1 MeV neutrons downshifted in energy by elastic scattering. The detector consists of a 0.1 cm thick Ta x-ray and debris shield backed by a 50 to 200 μm polyethylene radiator followed by layers of CR-39. The energy of each neutron producing a knock-on proton in the radiatior, that in turn creates a damage track in the CR-39, can be derived from the resultant track diameter, location, and orientation. We have analyzed the proton sensitivity and sample readability of 5 types of CR-39 in the energy range 3 to 11 MeV and have found a type fabricated by American Acrylics from a monomer made by a French company, Allymer, to be the most acceptable. Calibration curves were obtained for this plastic at energies of 3 to 15 MeV and dip angles ranging from 75 to 90°. These curves were subsequently used to unfold a 14.7 MeV spectrum generated at the Livermore Rotating Target Neutron Source.

1693 **(UCRL—88995) Novette pulse-power-system description.** Gritton, D.G.; Christie, D.J.; Holloway, R.W.; Merritt, B.T.; Oicles, J.A.; Whitham, K.; Wilcox, R.B. (Lawrence Livermore National Lab., CA (USA)). 1983. Contract W-7405-ENG-48. 7p. (CONF-830406—111). NTIS, PC A02/MF A01. Order Number DE83018185.

From 5. topical meeting on technology of fusion energy; Knoxville, TN, USA (26 Apr 1983).

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This paper is a summary of the pulse power systems for Novette; the flashlamp power system, the pulsers for the various optical shutters and the pulse power control system.

1694 **Return-current heating and implosion of cylindrical CO_2-laser—driven targets.** Hauer, A.; Mason, R.J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **51**: No. 6, 459-462(8 Aug 1983).

The Helios laser system has been used to deliver 2.3 kJ to the capped end of 0.75-mm-long, 130-μm-diam hollow rods of 5-μm wall thickness. Soft—x-ray pinhole pictures demonstrate the cylindrical implosion of these targets. The measured 130-eV core temperatures from the filtered pictures and the 7×10^6-cm/s collapse velocity from optical streak photographs are consistent with heating by a 0.8×10^6-A return current, representing the recycling of 15% of the hot-electron emission.

1695 **Nuclear spin-polarized fuel in inertial fusion.** More, R.M. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **51**: No. 5, 396-399(1 Aug 1983). Contract W-7405-ENG-48.

This Letter examines the possibility of using spin-polarized DT fuel for inertial-confinement fusion. Analytic models and esti-

mates are developed to determine whether an initial spin-polarized state would survive target irradiation and implosion. It is found that collisional depolarization cross sections are not large enough to give significant depolarization, and that the short duration of inertial-fusion implosions precludes spin resonance for magnetic fields that can be reasonably expected in the target fuel.

1696 **Measurement of the recombination rate coefficient of a tokamak vacuum vessel wall.** Howe, H.; Langley, R. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **1**: No. 3, 1435-1440(Jul 1983). Contract W-7405-ENG-26.

The recombination rate coefficient of the ISX-B vacuum vessel wall has been measured by observing the rate of decrease of gas pressure in the vesssel during a glow discharge. A simple analytic expression which relates the rate of change of the pressure to the recombination rate is derived and verified by comparison with a complete numerical simulation. Comparison of the recombination coefficient measured in ISX-B with previous laboratory measurements shows that the measured value is typical for a stainless steel surface covered with an oxide layer.

1697 **Effect of Divertor Geometry on impurity exhaust.** Ohyabu, N.; DeBoo, J.C.; Groebner, R.J.; Hsieh, C.L.; Ali Mahdavi, M.; Taylor, T.; Wesley, J.C. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **23**: No. 3, 295-302(Mar 1983).

The effect of poloidal divertor geometry on the exhaust of impurities is studied experimentally. In the expanded-boundary geometry, strong accumulation of argon in the divertor region and minimal reflux into the main plasma are observed. A simple model provides an explanation for the observations and leads to the conclusion that the two key geometrical factors for effective impurity control are an expansion of the divertor channel and a narrow gap between the divertor channel and the wall.

1698 **Mission, concept, and objectives of the fusion engineering device (FED).** Conn, R. (California Univ., Los Angeles (USA). School of Engineering and Applied Science); Clarke, J. (Department of Energy, Washington, DC (USA). Office of Fusion Energy); Furth, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Gilleland, J. (General Atomic Co., San Diego, CA (USA)); Montgomery, B. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center); Sheffield, J. (Oak Ridge National Lab., TN (USA)); Thomassen, K. (Lawrence Livermore National Lab., CA (USA)). pp 139-157 of Fusion reactor design and technology. Proceedings of the third technical committee meeting and workshop organized by the IAEA and held in Tokyo, Japan, 5-16 October 1981. Vol. 1. Vienna, Austria; IAEA (1983). (CONF-811046—; IAEA-TC—392/9).

From Meeting and workshop on fusion reactor design and technology; Tokyo, Japan (5 Oct 1981).

A fusion engineering device (FED) will play a central role in an engineering feasibility program to develop magnetic fusion energy. A working definition of engineering feasibility is developed by grouping the problems into three categories: plasma production technologies; nuclear technologies; and systems engineering and integration technologies. From this, a statement of mission and specific objectives are developed for an FED reactor whose characteristics are that it generates 200 MW of fusion power at a neutron wall loading of 0.5 MW/m^2 and a plasma amplification factor, Q, of 5 or more utilizing reactor-relevant technologies. The concept of the FED represents an ambitious but reasonable step in physics and technology. It incorporates features which can extrapolate to an attractive reactor system. Stages of device operation and the timetable to meet specific objectives demonstrate how construction of the FED will provide the information required to proceed to a Fusion Demonstration Plant (FDP).

1699 **Overview of the fusion engineering device (FED) design.** Steiner, D.; Flanagan, C.A. (Oak Ridge National Lab., TN (USA)). pp 159-171 of Fusion reactor design and technology. Proceedings of the third technical committee meeting and workshop organized by the IAEA and held in Tokyo, Japan, 5-16 October 1981. Vol. 1. Vienna, Austria; IAEA (1983). (CONF-811046—; IAEA-TC—392/10).

From Meeting and workshop on fusion reactor design and technology; Tokyo, Japan (5 Oct 1981).

During 1981, the Fusion Engineering Design Center (FEDC), under the guidance of a Technical Management Board (TMB), developed a baseline design for the Fusion Engineering Device (FED). This design is summarized herein. The device has a major radius of 5.0 m with a plasma minor radius of 1.3 m elongated by 1.6. Capability is provided for operating the toroidal field coils up to 10 T, but the bulk of the operations are designed for 8 T. At 8-T conditions, the fusion power is approx.180 MW (neutron wall loading approx.0.4 MW/m^2) and a plasma Q of approx.5 is expected. At 10-T conditions, which are expected to be limited to about 10% of the total operations, the fusion power is approx.450 MW (approx.1.0 MW/m^2) and ignition is expected. In developing the device configuration, maintenance and cost were the key nonphysics drivers. The plasma chamber is assembled by inserting ten shield sectors into a spool support structure. Ten toroidal field (TF) coils (7.4- by 10.9-m bore) are employed and produce a 3.6 T field (8 T) or 4.6 T field (10 T) on axis. Options for the TF coils include superfluid-helium-cooled NbTi, sub-cooled NbTi and a hybrid coil consisting of both NbTi and Nb_3Sn. The poloidal coil system incorporates both normal copper coils (inside the TF coils) and superconducting NbTi coils (outside the TF coils). Plasma bulk heating is accomplished using 50 MW of ion cyclotron resonance heating (ICRH). Electron cyclotron resonance heating (ECRH) is used for startup assist. A mechanical pump limiter, located at the bottom of the plasma chamber, establishes the plasma edge and is used to pump hydrogen and helium particles. The first wall consists of water-cooled stainless steel panels complemented with passively cooled graphite armor on the top and inboard walls and on each side of the limiter. The inboard shield is 60 cm thick and the outboard shield is 120 cm thick. This design provides the basis upon which a full conceptual design effort can be initiated.

1700 **Recent progress in design studies for tokamak demonstration and commercial power plants.** Abdou, M.A.; Baker, C.C.; Brooks, J.; Ehst, D.; Mattas, R.; Smith, D.L. (Argonne National Lab., IL (USA)). pp 231-272 of Fusion reactor design and technology. Proceedings of the third technical committee meeting and workshop organized by the IAEA and held in Tokyo, Japan, 5-16 October 1981. Vol. 1. Vienna, Austria; IAEA (1983). (CONF-811046—; IAEA-TC—392/15).

From Meeting and workshop on fusion reactor design and technology; Tokyo, Japan (5 Oct 1981).

This paper presents a summary of the results of two major tokamak design studies: a commercial power reactor study (STARFIRE) completed recently and a Demonstration Power Plant (DEMO) study presently in progress. Both studies involved participation of national laboratories, industry, and utilities. Great incentives were identified for developing the option of steady-state plasma operation in tokamaks. A number of non-inductive current drivers were investigated. Minority heating by ICRH appears to be one of the least efficient drivers, on a par with neutral beam injection. The most desirable current drive method appears to be pulsed injection of a relativistic electron beam, although pulsed techniques can also benefit other drivers. A limiter/vacuum concept has been developed for impurity control and exhaust. The advantages of this concept are: (1) manageable heat loads on the collection medium; (2) high tritium burnup leading to low tritium inventory; and (3) engineering simplicity compatible with ease of assembly/disassembly and maintenance. Although liquid lithium offers substantial advantages as a breeding material and coolant, the magnitude of the stored chemical energy is an important safety concern. The less reactive liquid metals and solid breeders were investigated. One of the difficult problems with solid breeders is the development of an efficient tritium recovery scheme to keep the tritium inventory in the blanket to a low level. Another difficulty with many solid breeders is a low tritium breeding potential. Trade-off studies com-

paring helium and water as coolants show clear advantages for the use of pressurized water in tokamaks if the temperature of the structural material is limited to approx. 500 deg. C. The greatest uncertainties in the economics of future tokamak power plants are in the areas of plant availability and construction time. These are crucially dependent on ease of assembly, ease of maintenance, and component reliability.

1701 **WITAMIR-I: A tandem mirror power reactor.** Emmert, G.A.; Kulcinski, G.L.; Beyer, J.B. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). pp 457-473 of Fusion reactor design and technology. Proceedings of the third technical committee meeting and workshop organized by the IAEA and held in Tokyo, Japan, 5-16 October 1981. Vol. 1. Vienna, Austria; IAEA (1983). (CONF-811046—; IAEA-TC—392/27).

From Meeting and workshop on fusion reactor design and technology; Tokyo, Japan (5 Oct 1981).

A conceptual design of a near term commercial tandem mirror power reactor will be presented. The basic configuration utilizes Yin-yang minimum B end plugs with inboard thermal barriers, which are pumped by neutral beam injection. The maximum magnetic fields are 6.1 T, 8.1 T and 15 T in the central cell, Yin-yang, and thermal barrier magnets, respectively. The blanket utilizes $Pb_{83}Li_{17}$ as the coolant and breeder, and HT-9 as the structural material. This configuration yields a high energy multiplication (1.37), a sufficient tritium breeding ratio (1.07) and has a major advantage with respect to maintenance. A single stage direct convertor is used at one end and an electron thermal dump at the other end. The plasma Q is 28 at a fusion power level of 3000 MWsub(th); the net electrical output is 1530 MWe and the overall efficiency is 39%. Cost estimates indicate that WITAMIR-I is competitive with recent tokamak power reactor designs.

1702 **Fusion reactor design and technology.** Vienna, Austria; International Atomic Energy Agency (1983). vp. (CONF-811046—Vol.1).

From Meeting and workshop on fusion reactor design and technology; Tokyo, Japan (5 Oct 1981).

Abstracts for each paper were entered into the data base. (MOW)

1703 **Fusion reactor design and technology.** Vienna, Austria; International Atomic Energy Agency (1983). vp. (CONF-811046—Vol.2).

From Meeting and workshop on fusion reactor design and technology; Tokyo, Japan (5 Oct 1981).

Abstracts for each paper were included in the data base. (MOW)

1704 **Design of an engineering test facility.** Sager, P.H. (Oak Ridge National Lab., TN (USA)). pp 123-140 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

The fusion Engineering Test Facility is being designed to provide for engineering testing capability in a program leading to the demonstration of fusion as a viable energy option. It will combine power-reactor-type components and subsystems into an integrated tokamak system and provide a test bed to test blanket modules in a fusion environment. Because of the uncertainties in impurity control two basic designs are being developed: a design with a bundle divertor and one with a poloidal divertor. The two designs are similar where possible, the latter having somewhat larger toroidal field coils to accommodate removal of the larger torus sectors required for the single-null poloidal divertor. Details of the design are given and discussed.

1705 **Lithium technology development for fusion reactors.** Down, M.G.; Whitlow, G.A.; Bauerle, J.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). pp 157-162 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

An overview of recent progress in the Westinghouse Lithium Technology Program is presented. Corrosion characteristics and weight loss behavior of both austenitic and ferritic steels in flowing lithium are reported. Instrumentation development, including on-line impurity meters, lithium leak detection sensors and lithium aerosol monitoring, is described in detail. The implications of these activities for the design and operation of fusion reactor blankets are discussed.

1706 **Comparison of calculated and experimental neutron attenuation and streaming data for fusion reactor design.** Santoro, R.T.; Alsmiller, R.G. Jr.; Barnes, J.M.; Chapman, G.T. (Oak Ridge National Lab., TN (USA)). pp 163-169 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

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Integral experiments that measure the neutron and gamma-ray energy spectra resulting from the attenuation of approx. 14 MeV T(D,n)^{4}He reaction neutrons in laminated slabs of stainless steel type 304, borated polyethylene, and a tungsten alloy (Hevimet) and from neutrons streaming through a 30-cm-diameter iron duct imbedded in a concrete shield have been performed. The facility, the NE-213 liquid scintillator detector system, and experimental techniques used to obtain the measured data are described. The two-dimensional discrete ordinates radiation transport codes, calculational models, and nuclear data used in the analysis of the experiments are reviewed. The measured and calculated neutron energy spectra obtained for the attenuation experiments are in excellent agreement for shield compositions and thicknesses up to 412 g/cm^2 thick. The calculated gamma-ray spectra agree with the measured data to within 15% for the slabs containing stainless steel and borated polyethylene and within a factor of 5 when Hevimet is included in the shield composition. The calculated neutron spectra obtained for the streaming experiments are in good agreement with the measured data for the on-axis detector position. For the off-axis detector locations, the calculations overestimate the measurements by as much as factor of 5 depending on detector location.

1707 **Fusion blankets for high-efficiency power cycles.** Usher, J.L.; Lazareth, O.W.; Fillo, J.A.; Horn, F.L.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). pp 217-224 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

The efficiencies of blankets for fusion reactors are usually in the range of 30 to 40%, limited by the operating temperatures (500 deg C) of conventional structural materials such as stainless steels. In this project 'two-zone' blankets are proposed; these blankets consist of a low-temperature shell surrounding a high-temperature interior zone. A survey of nucleonics and thermal hydraulic parameters has led to a reference blanket design consisting of a water-cooled stainless steel shell around a BeO, ZrO_3 interior (cooled by argon) utilizing Li_2O for tritium breeding. In this design, approximately 60% of the fusion energy is deposited in the high-temperature interior. The maximum argon temperature is 2230 deg C leading to an overall efficiency estimate of 55 to 60% for this reference case.

1708 **Design studies of an aluminium first wall for INTOR.** Powell, J.R.; Fillo, J.A.; Yu, W.-S.; Hsieh, S.-Y. (Brookhaven National Lab., Upton, NY (USA)); Pearlman, H. (Rockwell International Corp., Canoga Park, CA (USA)); Kramer, R.; Franz, E.; Craig, A. (ALCOA, PA (USA)); Farrell, K. (Oak Ridge National Lab., TN (USA)). pp 225-232 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

Examination of the plasma performance expected for INTOR indicates that there will probably be high fluxes of charge exchange neutrals to the first wall. The average energies of these neutrals is sufficiently large, in the range of approximately 100 to 300 eV, so that substantial erosion of the first wall by sputtering appears likely. If the first wall is made thick enough to survive for the desired operating life of the reactor thermal stresses may be excessive. Under these conditions, the cyclical nature of the INTOR reactor operation could cause failure of the first wall by fatigue or crack-growth processes. A second concern is the effect of plasma disruptions on the integrity of the INTOR first wall. Every so often in existing Tokamak experimental facilities the plasma suddenly becomes unstable and rapidly dumps its stored energy onto a portion of the plasma chamber. In addition to the potentially high-erosion rates expected for INTOR, but depending on the plasma scenario, there may also be substantial heat flux to the first wall. It is with respect to the above concerns (erosion, evaporation, and high-heat flux) that the aluminium design is addressed.

1709 **NOEL - a no-leak fusion blanket concept.** Powell, J.R.; Yu, W.-S.; Fillo, J.A.; Horn, F.L.; Makowitz, H. (Brookhaven National Lab., Upton, NY (USA)). pp 233-240 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

Analysis and tests of a no-leak fusion blanket concept are described. Coolant cannot leak into the plasma chamber even if large through-cracks develop in the first wall. Blanket modules contain a two-phase material, 'A', that is solid on the inside of the module shell, and liquid in the interior. The solid layer is maintained by imbedded tubes carrying a coolant, 'B', below the freezing point of 'A'. Most of the 14-MeV neutron energy is deposited as heat in the module interior. The thermal energy flow from the module interior to the shell keeps the interior liquid. Pressure on the liquid 'A' interior is greater than the pressure on 'B', so that 'B' cannot leak out if failures occur in coolant tubes. Liquid 'A' cannot leak into the plasma chamber through first wall cracks because of the intervening frozen layer. The thermal hydraulics and neutronics of NOEL blankets have been investigated for various metallic (e.g., Li, Pb_2, LiPb, Pb) and fused salt choices for material 'A'. With metallic 'A' materials a frozen layer several cm thick is obtained for stagnant, liquid interiors. The behaviour of the various possible materials is discussed.

1710 **Mechanical technology unique to laser fusion experimental systems.** Hurley, C.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). pp 581-586 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

Hardware design for laser fusion experimental machines has led to a combination of engineering technologies that are critical to the successful operation of these machines. These large opto-mechanical systems are dependent on extreme cleanliness, accommodation to efficient maintenance, and high stability. These three technologies are the primary mechanical engineering criteria for laser fusion devices.

1711 **Technology for large tandem mirror experiments.** Thomassen, K.I. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). pp 587-592 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

Construction of a large tandem mirror (MFTF-B) will soon begin at Lawrence Livermore National Laboratory (LLNL). Designed to reach break-even plasma conditions, the facility will significantly advance the physics and technology of magnetic-mirror-based fusion reactors. This paper describes the objectives and the design of the facility.

1712 **Reconfiguration of Doublet III to facilitate a reactor simulation experiment.** Rawls, J.M. (General Atomic Co., San Diego, CA (USA)). pp 609-614 of Fusion technology 1980. Vol. 1. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

A design is presented for a large, dee-shaped vacuum vessel to replace the present vessel in the Doublet III facility. By virtue of the choice of device parameters, it will be possible to accurately model the startup scenarios presently envisioned for the first generation of ignition tokamaks. The device will also serve as a flexible test bed for the exploration of divertorless operation with reactor-like plasmas.

1713 **Control systems for sustaining neutral beam power supplies.** Cummins, J.D. (Aydin Energy Div., Palo Alto, CA (USA)). pp 711-716 of Fusion technology 1980. Vol. 2. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

A system is described which was designed for the MFTF system at the Lawrence Livermore Laboratory, but the approach has applications wherever high-power systems must be controlled. Microprocessor based logic was used for flexibility in the initial design process, and to permit easy modification of operation as required. An important consideration was the ability of the system to function reliably in the presence of electromagnetic interference produced by large switching currents, high switching voltages, and arcing in the neutral beam injection system. Extensive use of fiber-optics in this system provided noise immunity as well as voltage standoff between modules. Electrical links between modules utilize transmission lines isolated at both ends by means of optical couplers or relays. Power supplies are isolated from power line transients by shielded transformers, line filters, and by transient suppressors. The system is also required to operate in the fringe magnetic field of the superconducting magnets in the MFTF system. This restricted the choice of components and led to the selection of alphanumeric plasma display panels in the local control consoles. Data communication with the MFTF central control system is provided by an interface to CAMAC equipment.

1714 **Progress in computer-assisted diagnosis and control of neutral beam lines.** Theil, E.; Elischer, V.; Fiddler, J.; Jacobs, N.J.D.; Jacobson, V.; Lawhorn, R.; Uber, D.; Wilner, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 751-756 of Fusion technology 1980. Vol. 2. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

This paper discusses the principles that have guided the development of a computerized diagnostic and control system for both the Neutral Beam Systems Test Facility at Lawrence Berkeley Laboratory and the Doublet III neutral beams at the General Atomic Company. The emphasis is not on the particular details of the implementation, but on general considerations which have influenced the design criteria for the system. Foremost among these are the requirements of an appropriate human interface to the system, and effective use of a relational data base. Examples are used to illustrate how these principles are carried out in practice. A systems view of diagnostic programs is suggested in the light of our experience.

1715 **Sustaining neutral beam power supply system for the Mirror Fusion Test Facility.** Eckard, R.D.; Wilson, J.H.; Van Ness, H.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). pp 785-792 of Fusion technology 1980. Vol. 2. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

In late August, 1978, a contract was awarded to Aydin Energy Division, Palo Alto, California, for the design, manufacture, installation and acceptance testing of the Lawrence Livermore National Laboratory Mirror Fusion Test Facility (MFTF) Sustaining Neutral Beam Power Supply System (SNBPSS). This system of 24 power supply sets will provide the conditioned power for the 24 neutral beam source modules. Each set will provide the accel potential, the arc power, the filament power, and the suppressor power for its associated neutral beam source module. The design and development of the SNBPSS has progressed through the final design phase and is now in production. Testing of the major subassembly power supply is proceeding at Aydin and the final acceptance testing of the first two power supplies at LLNL is expected to be completed this year. Some details are presented.

1716 **MFTF neutral beam pulse power modulator.** Eckard, R.D.; Van Ness, H.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.); Hesselgrave, D.H. (Aydin Energy Div., Palo Alto, CA (USA)). pp 793-799 of Fusion technology 1980. Vol. 2. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

The NBIS (Neutral Beam Injection Source) of a fusion energy reactor requires pulsed, high-energy dc input power. An electron tube pulse modulator, together with control, monitoring and protection equipment, comprise a system to regulate and switch this power. The design and development of salient components for this system are described in this paper.

1717 **High power vacuum tube technology applied to fusion system components.** Carter, D.R.; Reed, R.E.; Stabley, J.D. (Radio Corp. of America, Lancaster, PA). pp 801-806 of Fusion technology 1980. Vol. 2. Oxford, England; Pergamon Press (1981). (CONF-800950—Vols.1-2; EUR—7035).

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In two volumes.

RCA has developed a high voltage switch tube for use in the Neutral Beam Power Systems (NBPS) on the Tokamak Fusion Test Reactor (TFTR) being built in Princeton, New Jersey, U.S.A. Furthermore, high power vacuum tube technology is being applied by RCA to also manufacture neutral beam sources for the Mirror Fusion Test Facility (MFTF) at Livermore, California. This paper will describe the present test results on the high power switch tube. A reliability improvement program will be briefly described which was implemented when the device was transferred from engineering development to factory production. This paper will also review the status of the neutral beam source program. Design reviews for new power products that are being placed in manufacturing are discussed. In addition to the basic design, the design review also includes materials, mechanical construction, assembly procedures, testing, and reliability. The status of the program accomplishment to date will be highlighted.

99 GENERAL AND MISCELLANEOUS

1718 **(ORNL/TM—8875) Guidelines for graduate students in the Environmental Sciences Division, Oak Ridge National Laboratory.** Millemann, R.E. (ed.). (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 44p. NTIS, PC A03/MF A01. Order Number DE84002262.

The purpose of these guidelines is to outline the Environmental Sciences Division policies on the selection, placement, and research activities of graduate students. These guidelines have evolved through experience and in conformance with Oak Ridge National Laboratory (ORNL) policies. This edition of the Guidelines is a revision of one printed in June 1979, which had been prepared several years earlier by F.G. Goff, former Chairman of the Environmental Sciences Divison Education Committee. The present version differs from the previous one mainly in the addition of the colloquim and seminar requirements and in the revised procedures for preparation and typing of theses.

9901 Management

REFER ALSO TO CITATION(S) 1749

1719 **(DOE/SSDC—76-45/15) Work process control guide.** Bullock, M.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1979. Contract AC07-76ID01570. 50p. (SSDC—15). NTIS, PC A03/MF A01. Order Number DE84000495.

This guide identifies the elements necessary in the development and evaluation of the ingredients that make up the work process. It defines the interrelationships between people, plant, and procedures. Also, it provides managers, supervisors, and safety specialists with concepts, information, and techniques to use in establishing and maintaining adequate worksite control. The analytical tree is designed to set down, in a logical manner, factors which need consideration in a work process system. The tree is to be used in the conventional manner when analyzing an existing system. That is, one considers each element of the tree and makes judgments as to whether the element under consideration is adequate or less than adequate in maintaining adequate worksite control.

1720 **(K/D—5443) Management information system for engineering.** Green, R.O.; Morrison, J.M.; Wantland, R.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Aug 1983. Contract W-7405-ENG-26. 13p. (CONF-8310131—2). NTIS, PC A02/MF A01. Order Number DE84001655.

From American Society for Engineering Management annual meeting; Washington, DC, USA (17 Oct 1983).

The Engineering Management Information System (EMIS) is a computer based information system that integrates the business management systems of Union Carbide Corporation Nuclear Division's (UCC-ND) Engineering organization. This system serves the three DOE plants at Oak Ridge, Tennessee, and the uranium enrichment plant at Paducah, Kentucky. System scope includes engineering work load, forecasting, cost, schedule, and selected administrative information. EMIS has been developed to meet the overall objective of providing a single source of current, official data. It has been structured to meet a wide variety of needs, such as facilitating both uniform support of project management requirements associated with the uniquely different missions of the plants and control of the day-to-day operations of the Engineering organization.

1721 **(KFA-ASS—359) Annual report 1981 of the Department of Safety and Radiation Protection.** Hille, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz). Mar 1982. 204p. (In German.). Available from Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe (Germany, F.R.).

Radiation protection involves control of all KFA facilities including radiation monitoring, maintenance of the radiation measuring equipment and control of nuclear material. In the field of environmental protection monitoring of the release of gaseous and liquid material and of the environment is performed. The field of industrial safety includes the requirements of sect. 6 of the Law on Safety at Work. The subdepartment of security inspection is charged with controlling the KFA facilities and the transports of radioactive material. The department also has to plan and carry out the necessary emergency measures. In addition tasks of administration and organization have to be performed. Two research projects in the fields of dispersion of pollutants in the atmosphere and advancement of radiation measuring methods serve the improvement of environmental protection and radiation protection of the personnel.

1722 **(LBL-PUB—465) Catalog of research projects at Lawrence Berkeley Laboratory, 1983-1984.** (Lawrence Berkeley Lab., CA (USA)). Sep 1983. Contract AC03-76SF00098. 95p. NTIS, PC A05/MF A01. Order Number DE84001830.

Projects are reported by the following divisions: Accelerator and Fusion Research, Applied Science, Biology and Medicine, Chemical Biodynamics, Earth Sciences, Engineering and Technical Services, Materials and Molecular Research, Nuclear Science, and Physics, Computer Science, and Mathematics.

1723 **(PNL-SA—11512) Management and display of data analysis environments for large data sets.** Burnett, R.A.; Cowley, P.J.; Thomas, J.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 11p. (CONF-830950—2). NTIS, PC A02/MF A01. Order Number DE84001414.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper describes ongoing research at Pacific Northwest Laboratory (PNL) in data management and display techniques for multiple data analysis environments. Specifically, research is being conducted in four major areas: (1) the development of a model of the data analysis process incorporating the concepts of data analysis environments; (2) the design and use of data modification definitions (differential files) to represent multiple versions of a large data base; (3) the use of data dictionaries/directories to manage, describe, and control multiple data analysis environments; and (4) the application of graphical display and interaction techniques to the examination and selection of data analysis environments. The results of these research efforts will be integrated to provide a new dimension in interactive data analysis.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 511, 970, 1024, 1107, 1405, 1622, 1723

1724 **(ANL—83-76) Full- and half-range theory of indefinite Sturm-Liouville problems.** Kaper, H.G.; Kwong, M.K.; Lekkerkerker, C.G.; Zettl, A. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 53p. NTIS, PC A04/MF A01. Order Number DE84001672.

This report is concerned with eigenvalue problems of the form Au = lambda Tu, where A is a selfadjoint positive differential operator and T a selfadjoint indefinite multiplicative operator on a Hilbert space H. Three particular cases are discussed in detail. In the first case, A is positive definite and T is unitary; in the second case, A is positive definite and T is bounded, but T^{-1} is unbounded; in the third case, A is positive, dim ker(A) = 1, and T is bounded, but T^{-1} is unbounded. Emphasis is on the full-range and half-range expansion properties of the eigenfunctions. 15 references.

1725 **(ANL/NESC—1002R) SCREEN: statistical analysis of input data sensitivity.** Vaurio, J.K. (Argonne National Lab., IL (USA)). [nd]. Contract W-31-109-ENG-38. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049002.

Microfiche only, copy does not permit paper copy reproduction50K bytes of memory are required for execution; OS/MVT, MVS.

SCREEN is a statistical sensitivity analysis procedure for ranking input data of large computer codes in the order of sensitivity-importance. The problem is to determine a group of the most important input parameters of a computer code when the total number of input variables is large, so large that standard sensitivity evaluations varying each input variable (one or two at a time) would be prohibitively expensive.

1726 **(ANL/NESC—1021) TREDRA: computer drafting of fault trees.** Baker, L.S.; Cate, C.L. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). [nd]. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049007.

Microfiche only, copy does not permit paper copy reproduction70K bytes of memory are required for execution. OS/MVT;MVS.

TREDRA is a computer program for drafting report-quality fault trees. The input to TREDRA is similar to input for standard computer programs that find minimal cut sets from fault trees. Output includes fault tree plots containing all standard fault tree logic and event symbols, gate and event labels, and an output description for each event in the fault tree. TREDRA contains the following features: a variety of program options that allow flexibility in the program output; capability for automatic pagination of the output fault tree, when necessary; input groups which allow labeling of gates, events, and their output descriptions; a symbol library which includes standard fault tree symbols plus several less frequently used symbols; user control of character size and overall plot size; and extensive input error checking and diagnostic oriented output. Fault trees are generated by user-supplied control parameters and a coded description of the fault tree structure consisting of the name of each gate, the gate type, the number of inputs to the gate, and the names of these inputs.

1727 **(ANL/NESC—1022) PLUTO: plotting of molecular and crystal structures.** Motherwell, W.D.S. (Cambridge Univ. (UK). Library). [nd]. Mag. tapep. Computer software package available from NTIS and the National Energy Software Center, ANL. Order Number DE83049008.

Paper copy only, copy does not permit microfiche production50K bytes of memory and a plotting device. MVS.

PLUTO: may be used for drawing individual molecules in a crystalline arrangement. The drawings may be thought of in three principal aspects, the content, the style, and the viewpoint. the content of the drawing requires the definition of items such as molecules, atoms within molecules, connections between atoms, labels for atoms and unit cell representation. The style of the drawing may be like a stick model or a solid ball and spoke model with variable sizes for atoms and bonds. The atoms may be shaded to enhance the solid appearance. Drawings may be made in parallel projection, perspective, or in stereo-pair perspective. The view direction may be chosen with respect to molecular features such as lines and planes defined by atom names or by reference to the cell and orthogonal axial systems. The view direction may be further modified by rotation about the plotting reference axes. There are three distinct axial systems involved in drawing a crystal structure. The input coordinates are usually with reference to the unit cell axes and are in fractional form. These are converted internally to an orthogonal system. The final plotting coordinates are in millimeters and refer to the direction on the plotting paper. All these axes are right-handed, and absolute configuration is preserved in all rotations.

1728 **(BDX—613-2981) Off-line graphics processing: a case study.** Harris, D.D. (Bendix Corp., Kansas City, MO (USA)). Sep 1983. Contract AC04-76DP00613. 44p. (CONF-831193—1). NTIS, PC A03/MF A01. Order Number DE84002420.

From Applicon user's group fall technical meeting; Detroit, MI, USA (6 Nov 1983).

The Drafting Systems organization at Bendix, Kansas City Division, is responsible for the creation of computer-readable media used for producing photoplots, phototools, and production traveler illustrations. From 1977 when the organization acquired its first Applicon system, until 1982 when the off-line graphics processing system was added, the production of Gerber photoplotter tapes and APPLE files presented an ever increasing load on the Applicon systems. This paper describes how the organization is now using a VAX to offload this work from the Applicon systems and presents the techniques used to automate the flow of data from the Applicon sources to the final users.

1729 **(HEDL-TME—82-46-Rev.1) Concurrent Pascal for RSX-11M.** Corrigan, N.B. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76FF02170. 121p. NTIS, PC A06/MF A01. Order Number DE84002740.

The Concurrent Pascal programming language allows processes defined within a single program to run concurrently and cooperate on a common task. The principal feature of Concurrent Pascal is the monitor construct, which synchronizes process operations and defines data structures to be shared among concurrently executing processes. A straightforward and reliable implementation of systems designed for operation in a concurrent environment results from the use of concurrent programming, making Concurrent

Pascal an ideal language for the development of real-time applications. An implementation of Concurrent Pascal for use on Digital Equipment Corporation PDP-11 and LSI-11 computer systems running the RSX-11M V4.1 operating system is presented, and several programs demonstrating the use of Concurrent Pascal are provided.

1730 **(K/CSD/INF—83/20) Computer-output microfiche (COM) on the Oak Ridge computer network.** O'Hara, F.M. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Aug 1983. Contract W-7405-ENG-26. 84p. NTIS, PC A05/MF A01. Order Number DE84002422.

The computer network at the Department of Energy research and production plants in Oak Ridge has the capability of producing computer output microfiche on centralized facilities. Different computers in the network have different ways to access this output capability. These different ways are: the output class Q, the cataloged procedure PCOM, the utility program LCOM, the MIC file COM, and user-written macros. The uses of these different methods are explained and described in this manual, and examples of their use are presented.

1731 **(LA—9728-M) EOSPAC: a subroutine package for accessing the Los Alamos Sesame EOS data library.** Cranfill, C.W. (Los Alamos National Lab., NM (USA)). Aug 1983. Contract W-7405-ENG-36. 48p. NTIS, PC A03/MF A01. Order Number DE84002292.

This manual describes EOSPAC, a subroutine package for accessing the Los Alamos Sesame equations of state (EOS) data library, EOSPAC is designed for easy implementation in most hydrocodes running on the Los Alamos Cray-1 computers. The Sesame EOS data are in tabular form and are accessed in two phases. During the set-up phase, the requested data tables are read into a storage area and converted to a form suitable for the host code. During the search-interpolate phase, the stored data tables are used to compute the EOS values required by the host code. The set-up routines are called only at problem initialization and hence use little computer time. The search-interpolate routines, however, are called throughout problem execution and hence have been heavily vectorized for the Los Alamos Cray-1 computers. The EOS data available through EOSPAC include thermodynamic properties (e.g., pressure and specific energy) and transport coefficients (e.g., opacity and conductivity).

1732 **(LA-UR—83-1207) Benchmarking unstructured systems.** Brice, L.; Connell, J.; Lockhart, G. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 13p. (CONF-831202—1). NTIS, PC A02/MF A01. Order Number DE83011175.

From CHI '83 conference; Cambridge, MA, USA (12 Dec 1983).

Systems developed without the advantage of structured techniques can currently be found, even though most managers agree that the lack of such techniques is apt to produce an inferior product. When an unstructured system is identified, management must decide if it should be rewritten according to modern standards. The case study presented here describes how management in one Data Processing shop made that decision and learned something about their perceptions of the staff as well. To be judged successful, a system should be friendly, useful and easily maintainable. Research has shown that psychologically complex programs are more expensive to maintain than those developed with structured techniques, free from such complexity. In this study, three suspect systems were statistically measured against a base system. When a suspect system proved at least as psychologically complex as the base system, future maintenance costs were assumed to be at least as high as for the benchmark system. In addition to judging whether or not a system should be rewritten to provide ease of maintenance, the study provided management with a more accurate view of programmer work habits. Programmers previously judged to be extremely competent had created a high level of psychological complexity which is expected to result in high maintenance costs when other programmers become responsible for the system.

1733 **(LA-UR—83-1392) Modeling the user in intelligent user interfaces.** Stoddard, M.L.;Douglass, R.J. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 9p. (CONF-831202—2). NTIS, PC A02/MF A01. Order Number DE83012664.

From CHI '83 conference; Cambridge, MA, USA (12 Dec 1983).

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A methodology for explicitly defining a model of a program's users and for evaluating the effectiveness of the user interface is presented. The development of an explicit user model will reduce user costs by both reducing the cost of software development and increasing user productivity. The components of the methodology are described, and an example of using the methodology in the development of an expert consultant system is given. The methodology can be useful in preliminary design and testing of such interactive software as electronic mail, information retrieval systems, editors, and management information systems.

1734 **(LA-UR—83-1500) CRAY-1 instruction analysis: a comparison of two methods.** Martin, J.L.; Warnock, T. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 24p. (CONF-831208—1). NTIS, PC A02/MF A01. Order Number DE83012778.

From 14. computer measurement group conference; Washington, DC, US (6 Dec 1983).

In an effort to obtain data for workload characterization and performance evaluation studies, statistics were gathered on the frequencies of individual instructions in codes executing on the Cray-1. Two methods were used for the collection of data: (1) direct dynamic counting of executing instructions and (2) sampling of instructions at regular intervals during execution of the code. This paper describes the implementation of both methods and compares the results obtained. We conclude that because the Cray-1 is a vector processor, the sampling technique produces skewed results that misrepresent the workload being examined. Therefore, although it is easier to implement, sampling produces inaccurate results and is an invalid approach to performance evaluation studies on a vector computer. The counting of instructions provides a valuable profile of instruction frequencies and is a stable basis on which to build performance estimations.

1735 **(LA-UR—83-1761) Vectorization of algorithms for solving systems of elliptic difference equations.** Buzbee, B.L. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 9p. (CONF-831111—3). NTIS, PC A02/MF A01. Order Number DE83014125.

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

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Today's fastest computers achieve their highest level of performance when processing vectors. Consequently, considerable effort has been spent in the past decade developing algorithms that can be expressed as operations on vectors. In this paper we define two types of vector architecture. We discuss the variation of performance that can occur on a vector processor as a function of algorithm and implementation, the consequences of this variation, and the performance of some basic operators on the two classes of vector architecture. We also discuss the performance of higher level operators, including some that should be used with caution. Using both basic and high level operators, we discuss vector implementation of techniques for solving systems of elliptic difference equations. Included are fast Poisson solvers and point, line, and conjugate gradient techniques.

1736 **(LA-UR—83-2678) Network file-storage system.** Collins, M.W.; Devaney, M.J.; Willbanks, E.W. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 10p. (CONF-8309165—1). NTIS, PC A02/MF A01. Order Number DE84001068.

From 3. annual computer users conference of the National Center for Atmospheric Research; Boulder, CO, USA (20 Sep 1983).

The Central File System (CFS) is a file management and file storage system for the Los Alamos National Laboratory's computer network. The CFS is organized as a hierarchical storage system:

active files are stored on fast-access storage devices; larger, less active files are stored on slower, less expensive devices; and archival files are stored offline. Files are automatically moved between the various classes of storage by a file migration program that analyzes file activity, file size and storage device capabilties. This has resulted in a cost-effective system that provides both fast access and large data storage capability.

1737 **(LA-UR—83-3049) Numerical methods for tracking interfaces.** Hyman, J.M. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 26p. (CONF-8305110—5). NTIS, PC A03/MF A01. Order Number DE84001730.

From Fronts, interfaces and patterns conference; Los Alamos, NM, USA (2 May 1983).

An overview is given of special numerical methods for tracking discontinuous fronts and interfaces. These methods include: surface tracking methods based on connected marker points along the interface, volume-tracking methods that track the volume occupied by the solution regions bounded by the interfaces, and moving mesh methods where the underlying mesh is aligned and moved with the interface. The pros and cons of the current methods are discussed, and a new method is proposed that overcomes some of the difficulties encountered in approximating equations with multiply interacting interfaces.

1738 **(ORNL—5819) Algorithm for computing significance levels using the Kolmogorov-Smirnov statistic and valid for both large and small samples.** Kurtz, S.E.; Fields, D.E. (Oak Ridge National Lab., TN (USA)). Oct 1983. Contract W-7405-ENG-26. 39p. NTIS, PC A03/MF A01. Order Number DE84001586.

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The KSTEST code presented here is designed to perform the Kolmogorov-Smirnov one-sample test. The code may be used as a stand-alone program or the principal subroutines may be excerpted and used to service other programs. The Kolmogorov-Smirnov one-sample test is a nonparametric goodness-of-fit test. A number of codes to perform this test are in existence, but they suffer from the inability to provide meaningful results in the case of small sample sizes (number of values $\leqq$ 80). The KSTEST code overcomes this inadequacy by using two distinct algorithms. If the sample size is greater than 80, an asymptotic series developed by Smirnov is evaluated. If the sample size is 80 or less, a table of values generated by Birnbaum is referenced. Valid results can be obtained from KSTEST when the sample contains from 3 to 300 data points. The program was developed on a Digital Equipment Corporation PDP-10 computer using the FORTRAN-10 language. The code size is approximately 450 card images and the typical CPU execution time is 0.19 s.

1739 **(SAND—82-1389) SALOGS simulation control language compiler (SALSIM) user's manual.** Acken, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1983. Contract AC04-76DP00789. 109p. NTIS, PC A06/MF A01. Order Number DE84002756.

The SAndia LOGic Simulator Version 4 (SALOGS-4) is an evolutionary development in logic simulation. A user of the code can determine the response of a digital circuit with very good accuracy and with an economical expenditure of computer time. Most digital circuits are easily modeled using either basic building block gates or functional elements. Input signals to drive the network are generated and simulation is controlled by means of a language called Simulation Control Language (SCL).

1740 **(SAND—83-2131) Spline transfer through IGES: CADCAM-001.** Fletcher, S.K. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01. Order Number DE84002757.

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Sandia National Laboratories has been assigned Lead Lab responsibility for integrating CAD/CAM activities throughout the DOE Nuclear Weapons Complex (NWC). Pilot projects involving exchange of actual or artificial data are being used to assess our current capabilities in the areas of electronic data transmission, translations between different CAD/CAM systems, etc. This report is the final report for one pilot project. It assesses the effectiveness of IGES (Initial Graphics Exchange Specification, defined in ANSIY14.26M-1981) in transferring interpolating splines between various CAD/CAM systems used in the NWC. The results are generally encouraging.

1741 **(SAND—83-2267C) Time delay estimation using the adaptive delay element.** Etter, D.M.; David, R.A. (Sandia National Labs., Albuquerque, NM (USA); Stanford Univ., CA (USA)). 1983. Contract AC04-76DP00789. 4p. (CONF-8310194—1). NTIS, PC A02/MF A01. Order Number DE84002042.

From Asilomar conference on circuits, systems and computers; Pacific Grove, CA, USA (31 Oct 1983).

Time delay estimation between two narrowband signals is a problem common to applications such as seismic and acoustical signal processing. Using a simple real-time adaptive delay element, we compare delay estimation accuracy for both stationary and nonstationary time delays as well as for varying input signal-to-noise ratios. The comparison includes a modification to the adaptive algorithm which yields a smoothed delay estimate.

1742 **(SLAC—261) Multiplicative models in projection pursuit.** Henry, D.H. (Stanford Linear Accelerator Center, CA (USA)). Aug 1983. Contract AC03-76SF00515. 67p. NTIS, PC A04/MF A01. Order Number DE84001142.

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Friedman and Stuetzle (JASA, 1981) developed a methodology for modeling a response surface by the sum of general smooth functions of linear combinations of the predictor variables. Here multiplicative models for regression and categorical regression are explored. The construction of these models and their performance relative to additive models are examined.

1743 **(SLAC-PUB—3207) Introduction to Modula-2 (Installation Code: SLA).** White, B. (Stanford Linear Accelerator Center, CA (USA)). Sep 1983. Contract AC03-76SF00515. 17p. (CONF-8308135—1). NTIS, PC A02/MF A01. Order Number DE84001490.

From SHARE 61 conference; New York, NY, USA (21 Aug 1983).

Modula-2 is a general, efficiently implementable systems programming language. While most of its structures are derived from Pascal, it overcomes many of the limitations of that language. It also provides a powerful alternative to Ada. This tutorial will present Modula-2's history and an overview of its features.

1744 **(SOL—83-18) Generation of feasible descent directions in continuous time linear programming.** Anstreicher, K.M. (Stanford Univ., CA (USA). Systems Optimization Lab.). Sep 1983. Contract AT03-76ER72018. 91p. NTIS, PC A05/MF A01. Order Number DE84002506.

The continuous time linear programming (CTLP) problem provides a unified formulation for a number of linear, constrained, dynamic optimization problems. This paper presents a new algorithm for the CTLP basis inversion problem which is simple, numerically stable, and convenient for formal analysis. The new basis inverse is then applied to solve the CTLP representation and pricing problems in a systematic manner. Using a new relationship between primal representation and dual repricing, a CTLP degenerate pivoting algorithm is derived which enlarges the class of problems to which the CTLP descent algorithm may be applied. Degenerate pivoting occurs in an induced semi-infinite ordinary LP, and may be viewed as the first rigorous implementation of point-pair analysis in continuous programming. Under a mild regularity condition, degenerate pivoting terminates with revised prices indicating optimality, or a feasible descent direction in the form of multiple nonbasic variables to be simultaneously introduced. A small example indicates that failure of the regularity condition is closely related to the failure of CTLP strong duality.

1745 **(UCID—19892) Performance evaluation of a host peripheral DES cryptographic controller implementing a capability protection scheme.** Buchanan, C.J.; Sorkin, A. (Lawrence Livermore National Lab., CA (USA)). 12 Sep 1983. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01. Order Number DE84002085.

The purpose of the investigation reported here was to measure the efficiency (speed) of the peripheral cryptographic controller implementing the secret-key capability protection operations. The major point of interest was to compare experimental measurements of the peripheral cryptographic controller operations with host software implementation of the secret-key capability operations. Once the measurements of the peripheral cryptographic controller have been established, the decisions of software or peripheral device implementation of secret-key capability protection can be determined for a particular host computer. This report presents the results of a performance test with a DEC VAX 11/780 and an attached peripheral cryptographic device. The cryptographic device is under prototype testing by LLNL for Xypher Security Systems and is referred to as the Secure Network Access Processor (SNAP).

1746 **(UCRL—89833) Use of 3D graphics in scientific data analysis.** Grotch, S.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1983. Contract W-7405-ENG-48. 8p. (CONF-8310208—1). NTIS, PC A02/MF A01. Order Number DE84000911.

From Defense computers-graphics '83 meeting; Washington, DC, USA (12 Oct 1983).

We are currently witnessing a remarkable revolution in our ability to collect, store, analyze, and display information. We now have available graphical tools of extraordinary power to aid the scientist/engineer in data analysis. Unfortunately, the great majority of those who could profit from such tools are simply not using them. The focus here is on several 3D techniques for displaying scientific data which have proved useful in routine applications. A number of examples illustrate the features needed to produce useful graphical displays.

1747 **(UCRL—89913) Software maintenance on FORTRAN libraries at a large computer installation.** Atkinson, B.; Sutherland, G. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1983. Contract W-7405-ENG-48. 7p. (CONF-831247—1). NTIS, PC A02/MF A01. Order Number DE84002008.

From Software maintenance workshop; Monterey, CA, USA (6 Dec 1983).

This paper describes some of the tools and procedures used to maintain a large library of FORTRAN service subroutines. A history of library development is given, and some aspects of testing are discussed.

1748 **(Y/CSD/INF—83/2) Security of distributed ADP systems: problems and solutions.** McClain, W.J. (Oak Ridge Y-12 Plant, TN (USA)). 1983. Contract W-7405-ENG-26. 29p. (CONF-830765—2). NTIS, PC A03/MF A01. Order Number DE84001585.

From 6. computer security conference; Denver, CO, USA (25 Jul 1983).

The major challenge of a distributed network is that of access control. The present generation of computers and Operating Systems do not provide us with all of the tools required to provide adequate and secure control, but these tools are coming. With technology comes capability, and that capability will provide not only greater distribution and easier access to data and information, but also the controls required to protect that data. We must continue not only to pursue this new distributed technology, but also to build in the features necessary to protect the information.

1749 **(Y/CSD/INF—83/3) INTERACT execute facility for job scheduling and manipulation.** Moore, J.T. (Oak Ridge Y-12 Plant, TN (USA)). Oct 1983. Contract W-7405-ENG-26. 65p. (CONF-8310190—1). NTIS, PC A04/MF A01. Order Number DE84001653.

From Cullinet user's week; New Orleans, LA, USA (3 Oct 1983).

INTERACT's Execute Facility and command set provide a very obvious and simple mechanism for computerizing the computer operations department. A production oriented shop typically has a large volume of batch jobs that are submitted on a regular schedule (e.g., daily, monthly) and these jobs are usually grouped into systems (e.g., payroll). Furthermore, within these systems, individual jobs that are related, if not dependent on each other, sometimes have to run in a particular sequence. It's usually the responsibility of a setup group within the computer operations department to see that these jobs are submitted on schedule, the results are checked, a pre-defined procedure is followed when things go wrong, and reports are distributed to appropriate people out in the field. I developed an online system, called the JES3 NETWORK MANAGER, using INTERACT and its Execute Facility to handle these functions for our setup group at Union Carbide Corporation, Nuclear Division.

1750 **Numerical solution of the Zakharov equations.** Payne, G.L.; Nicholson, D.R.; Downie, R.M. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). *Journal of Computational Physics;* **50**: No. 3, 482-498(Jun 1983).

A new algorithm for the numerical solution of the Zakharov equations is presented. This algorithm is explicit and it is second-order accurate. The convergence of the algorithm is demonstrated by numerically solving the Zakharov equations for several test cases.

9903 Information Handling

REFER ALSO TO CITATION(S) 159, 172, 173, 174, 619, 1720

1751 **(DOE/MA/40000—T2) Joint Atomic Information Exchange Group information management project. Task 2 briefing document. System specification and hardware/software purchase recommendations for JAIEG automated information management system.** Smith, M.G.; Schwab, G.M. (Science Applications, Inc., Schaumburg, IL (USA)). 21 Oct 1983. Contract AC05-83MA40000. 11p. NTIS, PC A02/MF A01. Order Number DE84001798.

In Task 1, Science Applications, Inc. (SAI) studied JAIEG procedures and identified several areas where JAIEG information processing activities can be automated to achieve greater system efficiency. A document was written outlining the functions and specifications of an automated JAIEG information management system. This document stated that several off-the-shelf software development tools - a database management package, a forms management package, a word-processing capability and a programming language - would greatly facilitate the implementation of the functions identified as primary candidates for computer automation. The purpose of Task 2 was to investigate the hardware and software alternatives that exist to meet the requirements developed in Task 1. A generic hardware/software specification has been developed. This specification includes criteria by which existing hardware systems and software packages were evaluated. A specific system purchase recommendation has been devloped based on these criteria. These results are to be presented to JAIEG and TIC/DOE staff for their review in working and formal briefings.

1752 **(DOE/MA/40000—T3) Joint Atomic Information Exchange Group information management project. Briefing outlining functions and specifications of JAIEG automated information management system.** Smith, M.G. (Science Applications, Inc., Schaumburg, IL (USA)). 20 Jul 1983. Contract AC05-83MA40000. 37p. NTIS, PC A03/MF A01. Order Number DE84001800.

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The Joint Atomic Information Exchange Group (JAIEG) was formed in 1959. JAIEG's charter was to be the agent to determine the transmissibility of atomic information to foreign governments or regional defense organizations. JAIEG, operating from the joint policy direction of the Deputy Assistant Secretary for Military Application under the Department of Energy and of the Assistant to the Secretary of Defense for Atomic Energy under the Department of Defense, determines in a uniform and consistent

manner the transmissibility of Restricted Data (RD) and Formerly Restricted Data (FRD). JAIEG also maintains records of all transmittal of such data, and maintains record copies of all information reviewed. This information exists only on paper and must be processed manually. JAIEG's work load has grown continuously with the size of its filing system. This has prompted an investigation of the potential benefits of automating JAIEG activities. Science Applications, Inc. (SAI) has studied JAIEG procedures and has identified several areas where JAIEG information processing activities can be automated to achieve greater system efficiency.

1753 **(PNL-SA—11513) ALDS project: motivation, statistical database management issues, perspectives, and directions.** Thomas, J.J.; Hall, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 8p. (CONF-830950—1). NTIS, PC A02/MF A01. Order Number DE84001412.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The Analysis of Large Data Sets (ALDS) project was initiated at the Pacific Northwest Laboratories in 1978 through funding from DOE/BES Applied Mathematical Sciences. At that time, it was evident that the technical community's ability to collect scientific data was far outstripping existing capabilities to manipulate, display, and analyze such large data sets. Therefore, a new research direction in the analysis of large data sets was established. The ALDS project is composed of a team of statisticians and computer scientists. Their close interaction has been a key factor in contributing to our discoveries and future directions for analyzing large data sets. To help guide this program, an interdisciplinary team of consultants and reviewers were gathered together on an periodic basis to review progress and suggest research directions. This paper will discuss the motivation and initial goals of the ALDS project, the impact of large data sets, the data management issues addressed by ALDS, current research tasks and their impact on statistical data base management, and perspectives.

1754 **(PNL-SA—11715) Data dictionary model for relational databases.** Seesing, P.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 21p. (CONF-8310182—2). NTIS, PC A02/MF A01. Order Number DE84002584.

From US fall DECUS symposium; Las Vegas, NV, USA (24 Oct 1983).

Data Dictionary is an important tool in information engineering, especially when the data is maintained in relational structures. Using the formal concepts from which relational DBMS technology is derived, it is possible to construct a meta-informational dictionary to model relational database. This general model can be used to evaluate the design of existing and planned databases, as well as modeling business or scientific data. Such a dictionary model is described and its potential uses and benefits are explored with emphasis on integrity constraints. Issues related to the balancing of such formal conceptualization against real-world operations are presented.

1755 **(SAND—82-2896) Description of the SNLA Engineering Release and Change System (ECS).** Dale, A.C. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1983. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01. Order Number DE84001472.

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This report defines the Engineering Release and Change System (ECS), including origination, review, final preparation, telecommunication, microfilming, reproduction, and distribution of engineering releases and changes. The automated retrieval of data from each release and change order transmitted over the Secure Automatic Communications Network, including file management and periodic reports generated from the ECS master file, is also described.

9905 Civilian Defense

REFER ALSO TO CITATION(S) 1156, 1157, 1158, 1159

1756 **(AD-A—130220/7) Development of a system dynamics model to evaluate the post-attack recovery capability of the Soviet Union. volume 1. Description and simulations. Final report Oct81-May 83.** Peterson, D.W.; Silverman, W.S.; Weil, H.B.; Willard, S.; Wood, W.T. (Pugh-Roberts Associates, Inc., Cambridge, MA (USA)). May 1983. 153p. NTIS, PC A08/MF A01.

A highly-robust, dynamic simulation model of the Soviet economy has been constructured to evaluate the likely economic response after various nuclear attacks or other severe disruptions, under various policies and assumptions. The model consists of a large system of nonlinear, recursive, time difference equations. The solution interval of the model is adjustable, with a maximum value of three weeks. The model represents the economy in twelve sectors. Each sector contains a detailed representation of production, distribution, supply constraints, finance, employment, pricing, and wages. Also included are a full input-output representation of the interconnections among the sectors, and the psychological responses of government planners, consumers, and the labor force. The model's equations are formulated to remain consistent and realistic for all values of the variables, including the most extreme conditions. Therefore, the model can realistically simulate any degree or time sequence of nuclear attacks, pre-attack surges, mobilization, or policy shifts. Simulation experiments with the model suggest that the Soviet economy is highly vulnerable to nuclear attack.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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AC01-82EP12079	**GCA Corp., Bedford, MA (USA). GCA Technology Div.**	
	9:1172	DOE/EP—0018/1
AC01-82ER30041	**Engineering and Economics Research, Inc., Vienna, VA (USA)**	
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AC01-83FE60338	**United Technologies Corp., South Windsor, CT (USA). Power Systems Div.**	
	9:670	DOE/FE/60338—T1
AC02-76CH00016	**Brookhaven National Lab., Upton, NY (USA)**	
	9:230	BNL-NUREG—33579
	9:256	NUREG/CR—3382
	9:528	BNL-NUREG—33096
	9:566	NUREG/CR—2986
	9:573	NUREG/CR—3340
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	9:1107	BNL—33736
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	9:1127	BNL—33692
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AC02-76CH03000	**Fermi National Accelerator Lab., Batavia, IL (USA)**	
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	9:1058	FERMILAB/TM—1215
	9:1072	FERMILAB/TM—1212
	9:1073	FERMILAB/TM—1213
	9:1074	FERMILAB/TM—1214
	9:1075	FERMILAB/TM—1218
	9:1076	FERMILAB/TM—1219

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AC02-76CH03073	**Princeton Univ., NJ (USA). Plasma Physics Lab.**	
	9:1647	PPPL—2033
	9:1648	PPPL—2039
	9:1649	PPPL—2043
	9:1650	PPPL—2044
	9:1651	PPPL—2047
	9:1685	PPPL—2040
AC02-76ER01195	**Illinois Univ., Urbana (USA). Dept. of Physics**	
	9:1465	DOE/ER/01195—488
AC02-76ER01545	**Chicago Univ., IL (USA). James Franck Inst.**	
	9:1508	DOE/ER/01545—339
AC02-76ER02542	**Princeton Univ., NJ (USA). Dept. of Chemistry**	
	9:914	DOE/ER/02542—2
AC02-76ER02875	**Purdue Univ., Lafayette, IN (USA). Dept. of Physics**	
	9:1430	DOE/ER/02875—T2
AC02-76ER03069	**Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachuse**	
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AC02-76ER03075	**J. W. Gibbs Laboratory, Yale University, New Haven, Connecticut 06511**	
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AC02-76ER03130	**Brown Univ., Providence, RI (USA). Dept. of Physics**	
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AC02-76ER03459	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering**	
	9:767	DOE/ER/03459—18
AC02-76ER13065	**Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627**	
	9:1472	Physical Review Letters 51 NO. 7. 534-537 (15 Aug 1983).
AC02-76ET52040	**Illinois Univ., Urbana (USA)**	
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AC02-76ET53048	**Wesleyan Univ., Middletown, CT (USA)**	
	9:1630	DOE/ET/53048—T2
AC02-76EV02040	**Chicago Univ., IL (USA). Dept. of Microbiology**	
	9:1278	DOE/EV/02040—15
	9:1284	Proceedings of the National Academy of Sciences of the United States of America 80 NO. 6.
AC02-76EV02986	**U.S. Military Academy, West Point, NY**	
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AC02-76EV03277	**Johns Hopkins University, Baltimore, MD**	
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AC02-76EV03490	**Rochester Univ., NY (USA)**	
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AC02-77CH00178	**Solar Energy Research Inst., Golden, CO (USA)**	
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AC02-77ER04216	**PRC Systems Services Co., McLean, VA (USA)**	
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AC02-77ET53001	**Arizona Univ., Tucson (USA). Dept. of Nuclear and Energy Engineering**	
	9:1629	DOE/ET/53001—5
AC02-77ET53068	**American Science and Engineering, Incorporated, Cambridge, Massachusetts 02139**	
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AC02-77EV04320	**Department of Chemistry, GRC Towers, University of Massachusetts, Amherst, Massachusetts 01003-0035**	
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AC02-78ER04948	**State Univ. of New York, Albany (USA)**	
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AC02-78ER10107	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	9:768	DOE/ER/10107—21
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AC02-78ET51013	**Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center**	
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	Massachusetts Inst. of Tech., Cambridge (USA)	
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AC02-78EV04733	**Institute of Cancer Research, New York, NY**	
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AC02-79ER10461	**Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy**	
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AC02-79ET10815	**Tennessee Univ., Tullahoma (USA). Space Inst.**	
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AC02-79ET21067	**Department of Chemical Engineering, University of New Hampshire, Durham, NH 03824**	
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AC02-79EV10305	**Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology**	
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AC02-80CS24310	**Ohio State Univ. Research Foundation, Columbus (USA)**	
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AC02-80ER10588	**Massachusetts Inst. of Tech., Cambridge (USA). Ceramics Processing Research Lab.**	
	9:811	DOE/ER/10588—4

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AC02-80ER10600	**Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering**	
	9:831	DOE/ER/10600—1
AC02-80ER10663	**Arizona Univ., Tucson (USA). Dept. of Physics**	
	9:1490	DOE/ER/10663—2
AC02-80ER10668	**Wright State Univ., Dayton, OH (USA)**	
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AC02-80ER10735	**Michigan Univ., Ann Arbor (USA). Dept. of Mechanical Engineering**	
	9:819	DOE/ER/10735—1
AC02-80RA50293	**Randomline, Inc., Huntingdon Valley, PA (USA)**	
	9:1358	DOE/RA/50293—1
AC02-81ER10837	**Minnesota Univ., Minneapolis (USA)**	
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AC02-81ER10855	**Brigham Young Univ., Provo, UT**	
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AC02-81ER10857	**Pennsylvania State Univ., University Park (USA). Dept. of Physics**	
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AC02-81ER10862	**Polytechnic Inst. of Brooklyn, NY (USA). Dept. of Physics**	
	9:1433	DOE/ET/10862—3
AC02-81ER10874	**Illinois Univ., Urbana (USA). Dept. of Microbiology**	
	9:1307	DOE/ER/10874—3
AC02-81ER10881	**Temple Univ., Philadelphia, PA (USA)**	
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AC02-81ER10897	**Southern Illinois Univ., Carbondale**	
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AC02-81ER40007	**Indiana Univ., Bloomington (USA)**	
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AC02-81ER40025	**Colorado Univ., Boulder (USA). Dept. of Physics**	
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AC02-81ER40033	**Rockefeller Univ., New York (USA)**	
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AC02-81EV10650	**Washington Univ., St. Louis, MO (USA). Edward Mallinckrodt Inst. of Radiology**	
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AC02-81EV10731	**Harvard Univ., Cambridge, MA**	
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AC02-82CH10115	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Architecture**	
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AC02-83CH10093	**Solar Energy Research Inst., Golden, CO (USA)**	
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AC02-83ER45023	**Wisconsin Univ., Madison (USA). Dept. of Physics**	
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AC03-76ET53057	**Los Alamos National Laboratory, Los Alamos, New Mexico 87545**	
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AC03-76SF00012	**University of California, Los Angeles**	
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	Lawrence Berkeley Lab., CA (USA)	
	9:433	LBL—16100
	9:436	LBL—15594
	9:443	LBL—16218
	9:449	LBL—16207
	9:450	LBL—16329
	9:601	LBL—16422
	9:602	LBL—16485
	9:706	LBL—16221
	9:783	LBL—16186
	9:784	LBL—16380
	9:785	LBL—16594
	9:786	LBL—16616
	9:837	LBL—15491-Rev.
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	Lawrence Berkeley Lab., CA (USA)	
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	9:919	LBL—16561
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	9:1542	Physical Review Letters 51 NO. 5. 363-365 (1 Aug 1983).
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AC03-76SF00515	**Stanford Linear Accelerator Center, CA (USA)**	
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AC03-76SF00700	**Energy Technology Engineering Center, Canoga Park, CA (USA)**	
	9:514	ETEC-TDR—82-2
AC03-77CS51212	**Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering**	
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AC03-78SF02034	**Gas-Cooled Reactor Associates, La Jolla, CA (USA)**	
	9:503	DOE/SF/02034—T84
AC03-79ER10483	**SRI International, Menlo Park, CA (USA). Chemical Kinetics Dept.**	
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AC03-80ET34034	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
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AC03-81CS40520	**Varigas Research, Inc., Timonium, MD (USA)**	
	9:727	DOE/CS/40520—T1
AC03-81ER10964	**Dynamics Technology, Inc., Torrance, CA (USA)**	
	9:963	DOE/ER/10964—T4
AC03-82ER52083	**JAYCOR, Santa Monica, CA (USA)**	
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AC03-82SF11664	**Sheinbaum (L) Co., Inc., Monrovia, CA (USA)**	
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AC04-76DP00053	**Monsanto Research Corp., Miamisburg, OH (USA). Mound**	
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	9:929	Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films 1 NO. 3. 1441-144
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AC04-76DP00613	**Bendix Corp., Kansas City, MO (USA)**	
	9:827	BDX—613-2989
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	9:1129	BDX—613-2961
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AC04-76DP00789	**Sandia National Labs., Albuquerque, NM (USA)**	
	9:101	SAND—83-0945C
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	9:1149	SAND—83-1799
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	Sandia National Labs., Albuquerque, NM (USA)	
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	9:1653	SAND—83-1673
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AC05-76OR00033	**Oak Ridge Associated Universities, TN**	
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AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
	9:491	HEDL-SA—2757-FP
	FW Energy Applications, Inc., Livingston, NJ (USA)	
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	Hanford Engineering Development Lab., Richland, WA (USA)	
	9:493	HEDL-SA—2976
	9:525	HEDL-SA—2920
	9:772	HEDL-SA—2907-FP
	Westinghouse Hanford Co., Richland, WA (USA)	
	9:1023	HEDL-SA—2986
	Hanford Engineering Development Lab., Richland, WA (USA)	
	9:1110	HEDL-SA—2847-FP
	9:1111	HEDL-SA—2859-FP
	9:1112	HEDL-SA—2864-FP
	9:1673	HEDL-SA—2883
	9:1674	HEDL-SA—2896
	9:1675	HEDL-SA—2910
	9:1676	HEDL-TME—83-27
	9:1729	HEDL-TME—82-46-Rev.1
AC06-76RL01830	**Pacific Northwest Lab., Richland, WA (USA)**	
	9:227	NUREG/CR—3445
	Battelle Pacific Northwest Labs., Richland, WA (USA)	
	9:243	EPRI-NP—3225
	Pacific Northwest Lab., Richland, WA (USA)	
	9:255	NUREG/CR—3259
	Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation	
	9:258	ONWI—9(83-1)
	Battelle Memorial Inst., Columbus, OH (USA)	
	9:259	ONWI—9(83-2)
	RE/SPEC, Inc., Rapid City, SD (USA)	
	9:260	ONWI—190(5)
	Woodward-Clyde Consultants, San Francisco, CA (USA)	
	9:261	ONWI—485
	Ohio State Univ. Research Foundation, Columbus (USA)	
	9:262	ONWI—495
	Battelle Columbus Labs., OH (USA)	
	9:263	ONWI—501
	Pacific Northwest Lab., Richland, WA (USA)	
	9:265	PNL—4754
	9:266	PNL—4834
	9:267	PNL—4848
	9:268	PNL-SA—11416
	9:286	PNL—4608-3
	9:287	PNL-SA—10836
	9:288	PNL-SA—11576
	9:302	PNL-SA—11640
	9:521	PNL-SA—11459
	Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center	
	9:526	PNL-TR—431-Vol.2(Oct 1983).
	Pacific Northwest Lab., Richland, WA (USA)	
	9:574	NUREG/CR—3384
	9:578	PNL—4902
	9:596	PNL—4623
	Auburn Univ., AL (USA). Dept. of Civil Engineering	
	9:598	PNL—4849
	Pacific Northwest Lab., Richland, WA (USA)	
	9:738	PNL—4505
	9:789	PNL-SA—11321
	9:790	PNL-SA—11364
	9:791	PNL-SA—11365
	9:813	PNL-SA—11711
	9:901	PNL-SA—11189
	9:902	PNL-SA—11435
	9:1124	PNL—3983
	9:1225	PNL-SA—11116
	9:1269	PNL—4845
	9:1333	Bulletin of Environmental Contamination and Toxicology 28 NO. 6. 682-690 (Jun 1982).
	RE/SPEC, Inc., Rapid City, SD (USA)	
	9:1388	BMI/OCRD—9
	Pacific Northwest Lab., Richland, WA (USA)	
	9:1723	PNL-SA—11512
	9:1753	PNL-SA—11513
	9:1754	PNL-SA—11715
AC06-76RL01857	**UNC Nuclear Industries, Inc., Richland, WA (USA)**	
	9:499	UNI—2462
	United Nuclear Industries, Inc., Richland, WA (USA)	
	9:500	UNI-SA—117
AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
	9:222	RHO-PB-SR—10B-CP-8/83
	9:223	RHO-PB-SR—10-B-CP-June-83
	9:269	RHO-BW-SA—298A-P
	9:270	RHO-PB-SR—10-B-WM-Sept.-83
	9:1400	RHO-BW-SA—295-P

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AC06-81ER40048	Washington Univ., Seattle (USA). Inst. for Nuclear Theory	
	9:1491	DOE/ER/40048—16
	Washington Univ., Seattle (USA). Dept. of Physics	
	9:1492	DOE/ER/40048—17
	Washington Univ., Seattle (USA). Nuclear Physics Lab.	
	9:1503	DOE/ER/40048—74-L3
	9:1537	DOE/ER/40048—75-L3
	Washington Univ., Seattle (USA)	
	9:1539	DOE/ER/40048—76-L3
	Washington Univ., Seattle (USA). Nuclear Physics Lab.	
	9:1557	DOE/ER/40048—79-L3
	9:1563	DOE/ER/40048—78-L3
AC07-76ID01570	EG and G Idaho, Inc., Idaho Falls (USA)	
	9:160	DOE/SSDC—76-45/16
	9:234	DOE/LLW—2
	9:242	EGG-FM—6045
	9:446	EGG-GTH—6376
	9:488	EGG-M—26782
	9:508	EGG-M—26282
	9:518	EGG—2273
	9:532	EGG-M—04683
	9:533	EGG-M—08283
	9:534	EGG-M—08483
	9:535	EGG-M—08883
	9:536	EGG-M—14582
	9:537	EGG-M—16182
	9:538	EGG-M—16283
	9:539	EGG-M—16383
	9:540	EGG-M—16483
	9:541	EGG-M—17582
	9:542	EGG-M—18983
	9:1360	DOE/SSDC—17
	9:1361	DOE/SSDC—76-45/4-Rev.2
	9:1362	DOE/SSDC—76-45/11-Rev.1
	9:1363	DOE/SSDC—76-45/12
	9:1364	DOE/SSDC—76-45/13
	9:1365	DOE/SSDC—76-45/14-Rev.1
	9:1366	DOE/SSDC—76-45/18
	9:1367	DOE/SSDC—76-45/19
	9:1368	DOE/SSDC—76-45/20
	9:1369	DOE/SSDC—76-45/21
	UNC Nuclear Industries, Inc., Richland, WA (USA)	
	9:1370	DOE/SSDC—76-45/22
	EG and G Idaho, Inc., Idaho Falls (USA)	
	9:1371	DOE/SSDC—76-45/23
	9:1372	DOE/SSDC—76-45/24
	9:1373	DOE/SSDC—76-45/25
	9:1719	DOE/SSDC—76-45/15
AC07-78ET10816	Department of Chemistry and Geochemistry, Montana College of Mineral Science and Technology, Butte,	
	9:904	Applied Spectroscopy 37 NO. 4. 379-384 (Jul 1983).
AC08-76NV00410	Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)	
	9:1154	DOE/NV/00410—78
AC08-78ET11395	Scientific Software-Intercomp, Sugar Land, TX (USA)	
	9:434	DOE/ET/11395—18
AC08-79ET27112	Univ. of Texas, Austin	
	9:1392	CONF-821199—(Aug 1983).
AC08-81NV10174	Louisiana Geological Survey, Baton Rouge (USA)	
	9:1379	CONF-8310193—1
AC08-82NV10249	Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center	
	9:197	DOE/NV/10249—6
AC08-83NV10282	EG and G, Inc., Goleta, CA (USA)	
	9:185	EGG—10282-2020
AC09-76SR00001	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	9:220	DP-MS—83-76
	9:221	DP-MS—83-103
	9:238	DP-MS—82-97
	9:239	DP-MS—83-75

Contract No.	Abstract No.	Report No.
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
	9:240	DP-MS—83-90
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	9:241	DPST—81-212
	Environmental and Chemical Sciences, Inc., Aiken, SC (USA)	
	9:285	DPST—83-737
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	9:517	DPST—82-340
	9:876	DP-MS—83-37
	9:877	DP-MS—83-40
	9:878	DP-MS—83-51
	9:879	DP-MS—83-67
	9:908	
	9:982	DP-MS—83-43
	9:1162	DPST—83-705
	9:1174	DP-MS—83-12
	9:1213	DPST—82-767
	9:1218	DPST—82-512
	9:1233	DPST—83-672
	9:1254	DPST—81-482
	9:1255	DPST—82-212
	9:1256	DPST—82-1077
	9:1257	DPST—83-679
	9:1258	DPST—83-689
	Environmental and Chemical Sciences, Inc., Aiken, SC (USA)	
	9:1260	DPST—82-990
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	9:1261	DPST—83-775
	9:1263	DP—1638
	9:1264	DP-MS—83-101
	Environmental Chemical Sciences, Inc., Aiken, SC (USA)	
	9:1265	DPST—83-738
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	9:1266	DPST—83-754
	9:1315	DPST—82-708
AC13-79GJ01692	High Life Helicopters, Inc., Puyallup, WA (USA)	
	9:209	GJBX—35-83-Prescott-B-AZ-Vol.2B
	9:210	GJBX—35-83-Prescott-B-AZ-Vol.2A
	9:211	GJBX—35-83-Prescott-A-AZ-Vol.2A
	9:212	GJBX—35-83-Prescott-A-AZ-Vol.2B
	9:213	GJBX—35-83-Prescott-A-B-AZ-Vol.1
AC15-76CL50003	Westinghouse Electric Corp., Madison, PA (USA). Advanced Energy Systems Div.	
	9:489	CONF-830607—27
AC19-78BC00047	New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center	
	9:138	DOE/BC/00047—T4
AC19-80BC10033	Keplinger and Associates, Inc., Tulsa, OK (USA)	
	9:139	DOE/BC/10033—8
AC19-80BC10355	Spears and Associates, Inc., Tulsa, OK (USA)	
	9:142	DOE/BC/10355—1
AC19-81BC10375	GCA Corp., Bedford, MA (USA). GCA Technology Div.	
	9:178	DOE/BC/10375—6
AC19-81BC10658	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	9:155	DOE/BC/10658—6

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AC20-77ET13108	Gulf Research & Development Company, Pittsburgh, Pennsylvania 15230	
	9:52	Industrial and Engineering Chemistry Process Design and Development 22 NO. 3. 538-544 (Jul
AC21-76ET10377	General Electric Company, Corporate Research and Development, Schenectady, New York	
	9:120	Journal of the Electrochemical Society 129 NO. 9. 2119-2126 (Sep 1982).
AC21-80MC14361	Physical Sciences, Inc., Andover, MA (USA)	
	9:25	DOE/MC/14361—1495
AC21-80MC14368	Brigham Young Univ., Provo, UT (USA). Combustion Lab.	
	9:113	DOE/MC/14368—1462
AC21-80MC14385	Clark Univ., Worcester, MA (USA). Dept. of Chemistry	
	9:26	DOE/MC/14385—1484
AC21-80MC14713	Department of Civil Engineering, University of Illinois, Urbana, Illinois 61801	
	9:91	Solar Energy XXV NO. 6. 1581-1596 (Jun 1983).
AC21-81FE05147	McKee (Davy) Engineers and Constructors, Cleveland, OH (USA)	
	9:105	DOE/FE/05147—1488
AC21-81MC16377	Department of Chemistry, The University of New Mexico, Albuquerque, New Mexico	
	9:83	Journal of the Electrochemical Society 130 NO. 5. 1029-1036 (May 1983).
AC21-81MC16412	Resource Technologies Group, Inc., Morgantown, WV (USA)	
	9:1451	DOE/MC/16412—1444
AC21-82MC19163	Scientific Design Co., Inc., New York (USA)	
	9:27	DOE/MC/19163—T9
AC21-82MC19210	General Electric Co., Schenectady, NY (USA). Research and Development Center	
	9:69	DOE/MC/19210—1492
AC22-80PC30021	Air Products and Chemicals, Inc., Allentown, PA (USA)	
	9:28	DOE/PC/30021—T13
AC22-80PC30204	Pittsburgh Univ., PA (USA). Dept. of Chemistry	
	9:157	DOE/PC/30204—T1
AC22-80PC30252	Department of Chemistry, Duquesne University, Pittsburgh, PA 15282	
	9:82	Fuel 62 NO. 6. 718-723 (Jun 1983).
AC22-81MC16427	Bechtel Group, Inc., San Francisco, CA (USA)	
	9:87	DOE/MC/16427—T2
AC22-81PC40267	Combustion Engineering, Inc., Windsor, CT (USA)	
	9:117	DOE/PC/40267—4
AC22-82PC50046	Pittsburg and Midway Coal Mining Co., Denver, CO (USA)	
	9:32	DOE/PC/50046—4
AC22-83PC62690	Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.	
	9:107	DOE/PC/62690—T1
AI01-76ET10393	NCB (IEA Grimethorpe) Ltd., Grimethorpe (UK)	
	9:1042	DOE/ET/10393—1459
	NCB (IEA Grimethorpe) Ltd., Barnsley, South Yorkshire (UK)	
	9:1043	DOE/ET/10393—1460
AI01-76ET20320	Southern Illinois Univ., Carbondale (USA). Coll. of Engineering and Technology	
	9:462	DOE/NASA/0007—1
	Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.	
	9:463	DOE/NASA/3303—2
	9:464	DOE/NASA/3303—3
	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
	9:465	DOE/NASA/20320—51
	9:466	DOE/NASA/20320—52
	9:467	DOE/NASA/20320—53
AI01-76ET20485	Hughes Aircraft Co., Long Beach, CA (USA). Support Systems	
	9:353	DOE/NASA—0207-1
AI04-80AL12726	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
	9:600	DOE/NASA/12726—23
AI05-79ET29016	Tennessee Valley Authority, Muscle Shoals, AL (USA)	
	9:479	DOE/ET/29016—1
AI08-76DP00351	National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office	
	9:1215	NVO—260
AI08-76DP00474	Geological Survey, Denver, CO (USA)	
	9:1403	USGS-OFR—83-642
AI08-79DP40092	Naval Research Lab., Washington, DC (USA)	
	9:595	NRL-MR—5205
AI19-82BC10749	National Bureau of Standards, Washington, DC (USA)	
	9:186	DOE/BC/10749—2
AP21-82MC21490	Mathematical and Computer Services, Inc., Morgantown, WV (USA)	
	9:194	DOE/MC/21490—1441
AP44-81R401058	Jones (A.C.), Pensacola, FL (USA)	
	9:308	DOE/R4/01058—T1
AS05-76ER01797	Florida State Univ., Tallahassee (USA). Dept. of Chemistry	
	9:913	DOE/ER/01797—100
AS05-76ER03992	Texas Univ., Austin (USA). Center for Particle Theory	
	9:1466	DOE/ER/03992—534
AS05-76ER04449	Texas A and M Univ., College Station (USA). Research Foundation	
	9:1467	DOE/ER/04449—44
AS05-76ER05034	Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy	
	9:1520	DOE/ER/05034—6
AS05-76EV03408	Texas Univ., Austin (USA). Lab. of Radiation Biology	
	9:1312	CONF-830710—10
AS05-77ET28462	Texas Univ., Austin (USA). Coll. of Engineering	
	9:435	DOE/ET/28462—1
AS05-77EV05572	Old Dominion University, Norfolk, VA	
	9:1240	Environmental Science and Technology 16 NO. 11. 785-790 (Nov 1982).
	9:1242	Marine Chemistry (Amsterdam) 11 91-95 (1982).
AS05-78ET52025	Georgia Inst. of Tech., Atlanta (USA)	
	9:1637	GTFR—43
AS05-78EV10133	Miami Univ., Coral Gables, FL (USA). Resource Recovery Group	
	9:300	DOE/EV/10133—T5
AS05-80ER10599	Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104	
	9:1585	Physical Review [Section] C: Nuclear Physics 28 NO. 2. 903-906 (Aug 1983).
AS05-80ER10662	Rutgers University, New Brunswick, NJ	
	9:943	Journal of Organic Chemistry 48 NO. 8. 1151-1154 (22 Apr 1983).
AS05-81ER10840	Kentucky Univ., Lexington (USA)	
	9:63	DOE/ER/10840—3
	9:65	DOE/ER/10840—3(1983).

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AS05-81ER40008	Physics Department, University of Florida, Gainesville, Florida 32611	
	9:1519	Annals of Physics (New York) 147 NO. 2. 365-416 (May 1983).
AS09-76EV00641	Georgia Univ., Athens (USA). Dept. of Entomology	
	9:1221	DOE/EV/00641—50
AS19-80BC10300	Oklahoma Univ., Norman (USA)	
	9:140	DOE/BC/10300—34
AS19-80BC10304	Oklahoma State Univ., Stillwater (USA)	
	9:141	DOE/BC/10304—17
AS19-80BC10310	University of Waterloo, Ontario	
	9:148	Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical an
	9:151	SPEJ, Society of Petroleum Engineers Journal 23 NO. 2. 311-326 (Apr 1983).
AT01-80NE93031	National Academy of Sciences, Washington, DC (USA)	
	9:237	DOE/NE/93031—T1
AT02-80CH94049	Westinghouse Electric Corp., Madison, PA (USA). Advanced Energy Systems Div.	
	9:1016	ANL/NESC—1018
AT03-76ER70102	University of California, Los Angeles	
	9:1286	Biochemistry 22 NO. 3. 611-617 (1 Feb 1983).
AT03-76ER70185	California Univ., Santa Cruz (USA). Dept. of Biology	
	9:1341	DOE/ER/70185—T2
AT03-76ER70217	California Univ., Irvine (USA). Dept. of Chemistry	
	9:949	DOE/ER/70217—T1
AT03-76ER72018	Stanford Univ., CA (USA). Systems Optimization Lab.	
	9:1623	SOL—83-15
	9:1744	SOL—83-18
AT03-76ET51011	General Atomic Company, P.O. Box 81608, San Diego, CA 92138	
	9:1003	IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics 19 NO.
	9:1004	IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics 19 NO.
	GA Technologies, Inc., San Diego, CA (USA)	
	9:1636	GA-A—17276
AT03-76SF70046	GA Technologies, Inc., San Diego, CA (USA)	
	9:504	GA-A—17112
AT03-80ER10647	Stanford Univ., CA (USA). Dept. of Chemistry	
	9:868	DOE/ER/10647—T1
AT03-81ER10870	California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials	
	9:769	DOE/ER/10870—142
	9:803	Physical Review Letters 51 NO. 5. 415-418 (1 Aug 1983).
AT06-76ER70035	Oregon State Univ., Corvallis (USA)	
	9:1521	DOE/ER/70035—6
AT06-76EV71025	Washington Univ., Seattle (USA). Coll. of Ocean and Fishery Sciences	
	9:1406	DOE/EV/71025—64
AT06-76EV73012	Washington State Univ., Pullman (USA)	
	9:1253	DOE/EV/73012—T1
AT06-81EV10611	Oregon State Univ., Corvallis (USA). School of Oceanography	
	9:1244	DOE/EV/10611—3
AT06-81RL10308	Washington State Univ., Pullman (USA). Coll. of Engineering	
	9:770	DOE/RL/10308—1
AT06-82ER12027	Washington State Univ., Pullman (USA)	
	9:1294	DOE/ER/12027—1
AT21-80MC14803	West Virginia Univ., Morgantown (USA). Coll. of Mineral and Energy Resources	
	9:86	DOE/MC/14803—T1
FC01-83MI10023	Central State Univ., Wilberforce, OH (USA)	
	9:624	DOE/MI/10023—T1
FC03-79ET27196	Imperial, County of, El Centro, CA (USA). Dept. of Public Works	
	9:432	DOE/ET/27196—T13
FC03-80ER10692	S.H.E. Corp., San Diego, CA (USA)	
	9:981	DOE/ER/10692—T1
FC07-81ID12193	WESTEC Services, Inc., San Diego, CA (USA)	
	9:453	DOE/ID/12193—3
FG01-78CS40179	Texas Agricultural Experiment Station, Lubbock (USA)	
	9:725	DOE/CS/40179—T1
FG01-80CS40338	North Carolina State Government, Raleigh (USA)	
	9:179	DOE/CS/40338—3
FG01-80CS65002	National Association of Counties Research Foundation, Washington, DC (USA)	
	9:661	DOE/CS/65002—T2
FG01-80RG10409	Colorado-Ute Electric Association, Inc., Montrose (USA)	
	9:659	DOE/RG/10409—T1
FG01-81AD11263	New Mexico Univ., Albuquerque (USA). Southwest Hispanic Research Inst.	
	9:622	DOE/AD/11263—T1
FG01-81CA10006	Center for Urban Environmental Studies, Inc., Washington, DC (USA)	
	9:616	DOE/CA/10006—T2
	9:623	DOE/CA/10006—T1
FG01-81CA10012	Federation of Organizations for Professional Women, Washington, DC (USA)	
	9:1271	DOE/CA/10012—T1
FG01-81CS15077	Zumbrunnen (Allen D.), Salt Lake City, UT (USA)	
	9:329	DOE/CS/15077—T7
FG01-81FE16122	Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.	
	9:304	DOE/FE/16122—1491-Vol.1
	9:305	DOE/FE/16122—1491-Vol.2
	9:306	DOE/FE/16122—1491-Vol.3
FG01-81RA50356	Texas Eastern Synfuels, Inc., Houston (USA)	
	9:35	DOE/RA/50356—1308-Vol.1
	9:36	DOE/RA/50356—1308-Vol.2
	9:37	DOE/RA/50356—1308-Vol.3
	9:38	DOE/RA/50356—1308-Vol.4A
	9:39	DOE/RA/50356—1308-Vol.4B
	9:40	DOE/RA/50356—1308-Vol.5
FG01-81RA50393	Hampshire Energy, Gillette, WY (USA)	
	9:41	DOE/RA/50393—T1-Vol.1
	9:42	DOE/RA/50393—T1-Vol.2
	9:43	DOE/RA/50393—T1-Vol.3
	9:44	DOE/RA/50393—T1-Vol.4
	9:45	DOE/RA/50393—T1-Vol.5
	9:46	DOE/RA/50393—T1-Vol.6
	9:47	DOE/RA/50393—T1-Vol.7
FG01-82EI19617	Minnesota Dept. of Energy, Planning and Development, St. Paul (USA)	
	9:161	DOE/EI/19617—T1
FG02-80CS84006	Stanford University, CA	
	9:1281	Biochemistry 22 NO. 12. 2923-2933 (7 Jun 1983).
FG02-81NE46640	Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey	
	9:235	DOE/NE/46640—8
	9:236	DOE/NE/46640—9
FG02-83ER75094	Illinois Univ., Urbana (USA)	
	9:481	DOE/ER/75094—2
	Virginia Univ., Charlottesville (USA)	
	9:507	DOE/ER/75094—3

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FG05-80ET53088	Texas Univ., Austin (USA). Inst. for Fusion Studies	
	9:1631	DOE/ET/53088—105
	9:1632	DOE/ET/53088—108
	9:1633	DOE/ET/53088—111
FG07-82ID12371	Colorado State Government, Denver (USA)	
	9:232	DOE/ID/12371—1
	9:233	DOE/ID/12371—6
FG22-80PC30232	North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering	
	9:29	DOE/PC/30232—T7
FG22-80PC30238	New Mexico Highlands Univ., Las Vegas (USA). Div. of Science and Mathematics	
	9:114	DOE/PC/30238—1
	9:115	DOE/PC/30238—2
	9:116	DOE/PC/30238—3
FG22-80PC30250	Pennsylvania State Univ., University Park (USA). Dept. of Chemistry	
	9:70	DOE/PC/30250—T1
FG22-81PC40285	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Energy and Environmental Studies	
	9:106	DOE/PC/40285—8
FG22-81PC40782	State Univ. of New York, Binghamton (USA). Dept. of Chemistry	
	9:30	DOE/PC/40782—T6
FG22-81PC40791	Mississippi State Univ., Mississippi State (USA). MHD Energy Center	
	9:71	DOE/PC/40791—T2
FG22-81PC40793	Western Kentucky Univ., Bowling Green (USA)	
	9:72	DOE/PC/40793—T8
FG22-81PC40800	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
	9:31	DOE/PC/40800—T3
FG22-81PC40805	Western Michigan Univ., Kalamazoo (USA). Dept. of Chemistry	
	9:964	DOE/PC/40805—6
FG22-81PC40810	North Dakota Univ., Grand Forks (USA). Dept. of Chemistry	
	9:73	DOE/PC/40810—7
FG22-82PC50787	Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering	
	9:33	DOE/PC/50787—T2
FG22-82PC50788	SRI International, Menlo Park, CA (USA)	
	9:74	DOE/PC/50788—T4
FG22-82PC50797	California Univ., Riverside (USA). Dept. of Chemistry	
	9:75	DOE/PC/50797—T3
FG22-82PC50801	Southern Illinois Univ., Carbondale (USA). Dept. of Physics	
	9:76	DOE/PC/50801—4
FG22-82PC50807	Duke Univ., Durham, NC (USA). Dept. of Chemistry	
	9:77	DOE/PC/50807—T4
FG22-82PC50809	Lehigh Univ., Bethlehem, PA (USA)	
	9:78	DOE/PC/50809—T3
FG22-82PC50810	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
	9:307	DOE/PC/50810—T4
FG22-83PC60813	Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering	
	9:34	DOE/PC/60813—1
FG44-78CS60124	North Carolina Dept. of Commerce, Raleigh (USA). Energy Div.	
	9:653	DOE/CS/60124—T1
FG44-80R410077	Norman (Rayford M., Sr.), Huntsville, AL (USA)	
	9:419	DOE/R4/10077—T1
FG44-80R410079	Harris (Thomas D.), Auburn, AL (USA)	
	9:728	DOE/R4/10079—T1
FG44-80R410091	Mowery (James W.), Oldsmar, FL (USA)	
	9:420	DOE/R4/10091—T1
FG44-80R410098	Knudsen (Edward T., Jr.), St. Petersburg, FL (USA)	
	9:373	DOE/R4/10098—T1
FG44-80R410102	Fielder (Mary V.), Gainesville, FL (USA)	
	9:679	DOE/R4/10102—T1
FG44-80R410105	Scarborough (Sidney M.), Biloxi, MS (USA)	
	9:597	DOE/R4/10105—T1
FG44-80R410106	Skinner (Ferrell S.), Iuka, MS (USA)	
	9:680	DOE/R4/10106—T1
FG44-80R410108	Mississippi Solar Co., Jackson (USA)	
	9:421	DOE/R4/10108—T1
FG44-80R410113	Trickel (Charles), Inverness, FL (USA)	
	9:374	DOE/R4/10113—T1
FG44-80R410117	SOLARFAB, Cary, NC (USA)	
	9:422	DOE/R4/10117—T1
FG44-80R410121	Saddlecraft, Inc., Cherokee, NC (USA)	
	9:681	DOE/R4/10121—T1
FG44-80R410122	Clemson Univ., SC (USA). Dept. of Ceramic Engineering	
	9:375	DOE/R4/10122—T1
FG44-80R410123	Henderson (Zachary W.), Roswell, GA (USA)	
	9:376	DOE/R4/10123—T1
FG44-80R410126	Spring (Samuel), Blairsville, GA (USA)	
	9:682	DOE/R4/10126—T1
FG44-80R410127	Covington State Area Vocational-Technical School, TN (USA)	
	9:377	DOE/R4/10127—T1
FG44-80R410128	Fort Sanders Development Corp., Knoxville, TN (USA)	
	9:683	DOE/R4/10128—T1
FG44-80R410129	Jacksonville Urban League, Inc., FL (USA)	
	9:378	DOE/R4/10129—T1
FG44-80R410131	Mad Dog Design and Construction, Inc., Tallahassee, FL (USA)	
	9:379	DOE/R4/10131—T1
FG44-80R410132	United Energy Technologies, St. Petersburg, FL (USA)	
	9:684	DOE/R4/10132—T1
FG44-80R410135	DeMayo (Ben), Carrollton, GA (USA)	
	9:380	DOE/R4/10135—T1
FG44-80R410136	Adams (W.D.), Austell, GA (USA)	
	9:381	DOE/R4/10136—T1
FG44-80R410139	Carolina Friends School, Inc., Durham, NC (USA)	
	9:685	DOE/R4/10139—T1
FG44-80R410140	Four Leaf Farm, Durham, NC (USA)	
	9:382	DOE/R4/10140—T1
FG44-80R410143	Home Park Community Improvement Association, Inc., Atlanta, GA (USA)	
	9:383	DOE/R4/10143—T1
FG44-80R410144	Solar Crafters, Inc., Strawberry Plains, TN (USA)	
	9:310	DOE/R4/10144—T1
FG44-80R410146	Dixie Fiberglass Products, Inc., Winter Garden, FL (USA)	
	9:686	DOE/R4/10146—T1
FG44-80R410147	John C. Campbell Folk School, Brasstown, NC (USA)	
	9:384	DOE/R4/10147—T1
FG44-80R410148	Alabama Solar Energy Center, Huntsville (USA)	
	9:385	DOE/R4/10148—T1
FG44-80R410150	Educational Planners and Evaluators, Oxford, MS (USA)	
	9:687	DOE/R4/10150—T1
FG44-80R410151	Cumberland Mfg. Co., Sparta, TN (USA)	
	9:729	DOE/R4/10151—T1
FG44-80R410156	Martin (Werner), Chapel Hill, NC (USA)	
	9:311	DOE/R4/10156—T1
FG44-80R410159	Long Branch Environmental Education Center, Inc., Leicester, NC (USA)	
	9:386	DOE/R4/10159—T1
FG44-80R410162	East Tennessee State Univ., Johnson City (USA)	
	9:688	DOE/R4/10162—T1
FG44-80R410205	Strubble (V.), Raleigh, NC (USA)	
	9:423	DOE/R4/10205—T1

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FG44-80R410208	Catawba Science Center, Hickory, NC (USA)	
	9:324	DOE/R4/10208—T1
FG44-80R410211	Miller (R.G.), Pineville, NC (USA)	
	9:689	DOE/R4/10211—T1
FG44-80R410214	Blue Ridge Group Sierra Club, Boone, NC (USA)	
	9:313	DOE/R4/10214—T1
FG44-80R410215	Moses (Ray), Greenville, SC (USA)	
	9:387	DOE/R4/10215—T1
FG44-80R410218	Cubit Engineering Ltd., Clemson, SC (USA)	
	9:457	DOE/R4/10218—T1
FG44-80R410219	CH2M Hill, Columbia, SC (USA)	
	9:743	DOE/R4/10219—T1
FG44-80R410220	Jarriel (Jack L.), Aiken, SC (USA)	
	9:690	DOE/R4/10220—T1
FG44-80R410224	Shirley (Jeff W.), Columbia, SC (USA)	
	9:388	DOE/R4/10224—T1
FG44-80R410226	Upper Sand Mountain Parish, Section, AL (USA)	
	9:389	DOE/R4/10226—T1
FG44-80R410230	Schaetzle (W.J.) and Associates, Inc., Tuscaloosa, AL (USA)	
	9:730	DOE/R4/10230—T1
FG44-80R410235	Farm, Summertown, TN (USA)	
	9:752	DOE/R4/10235—T1
FG44-80R410236	Hale (M.), Bone Cave, TN (USA)	
	9:691	DOE/R4/10236—T1
FG44-80R410238	Sanders (Willard), Old Hickory, TN (USA)	
	9:360	DOE/R4/10238—T1
FG44-80R410239	Johnson (Gus E.), Knoxville, TN (USA)	
	9:390	DOE/R4/10239—T1
FG44-80R410240	Tillman (Andrew), Huntsville, TN (USA)	
	9:731	DOE/R4/10240—T1
FG44-80R410241	Hillenbrand (Stephen J.), Knoxville, TN (USA)	
	9:692	DOE/R4/10241—T1
FG44-80R410242	Crichton (Joseph L.), Knoxville, TN (USA)	
	9:693	DOE/R4/10242—T1
FG44-80R410244	Whitehead (Nancy L.), Strawberry Plains, TN (USA)	
	9:391	DOE/R4/10244—T1
FG44-80R410249	Goerz (Jerry W.), Lexington, KY (USA)	
	9:468	DOE/R4/10249—T1
FG44-80R410250	Edwards (R.G.), Lexington, KY (USA)	
	9:694	DOE/R4/10250—T1
FG44-80R410251	Edwards (Thomas D.), Butler, KY (USA)	
	9:732	DOE/R4/10251—T1
FG44-80R410253	Schleper (Michael A.), Villa Hills, KY (USA)	
	9:695	DOE/R4/10253—T1-Pt.1
FG44-80R410255	Dahl (Kathy), Winchester, KY (USA)	
	9:392	DOE/R4/10255—T1
FG44-80R410256	Edmonson County Public Library, Brownsville, KY (USA)	
	9:393	DOE/R4/10256—T1
FG44-80R410258	Alcorn County Schools, Corinth, MS (USA)	
	9:696	DOE/R4/10258—T1
FG44-80R410263	Cloud (Nolan E.), Winterville, GA (USA)	
	9:394	DOE/R4/10263—T1
FG44-80R410265	Suber (Hollis), Thomasville, GA (USA)	
	9:756	DOE/R4/10265—T1
FG44-80R410275	Cash (Lee), Atlanta, GA (USA)	
	9:395	DOE/R4/10275—T1
FG44-80R410276	Goodwill Industries of Atlanta, Inc., GA (USA)	
	9:396	DOE/R4/10276—T1
FG44-80R410292	Lowstuter (W. Robert), St. Petersburg, FL (USA)	
	9:697	DOE/R4/10292—T1
FG44-80R410294	Benjamin (Charles M.), Cocoa Beach, FL (USA)	
	9:424	DOE/R4/10294—T1
FG44-80R410295	Starkey (Vonley J.), Kissimmee, FL (USA)	
	9:397	DOE/R4/10295—T1
FG44-80R410297	Fonash (Raymond L.), Little Torch Key, FL (USA)	
	9:398	DOE/R4/10297—T1
FG44-80R410298	Velso (J.), Tampa, FL (USA)	
	9:698	DOE/R4/10298—T1
FG44-80R410299	Florida Univ., Gainesville (USA)	
	9:301	DOE/R4/10299—T1
FG44-80R410301	Tyrrell (Frederick S.), Port Richey, FL (USA)	
	9:699	DOE/R4/10301—T1
FG44-80R410303	Outland (B.W.), Pensacola, FL (USA)	
	9:399	DOE/R4/10303—T1
FG44-80R410305	Sinz (E.), Miami, FL (USA)	
	9:325	DOE/R4/10305—T1
FG44-80R410306	S.R.D. Corp., Eastover, SC (USA)	
	9:400	DOE/R4/10306—T1
FG44-80R410312	Environmental Alternatives, Inc., Louisville, KY (USA)	
	9:401	DOE/R4/10312—T1
FG44-80R410313	Morehead State Univ., KY (USA)	
	9:402	DOE/R4/10313—T1
FG44-80R410314	Avery (Samuel C.), Upton, KY (USA)	
	9:403	DOE/R4/10314—T1
FG44-80R410315	Cheek (Frank L.), Suches, GA (USA)	
	9:715	DOE/R4/10315—T1
FG44-80R410328	Dickert (Phillip M.), North Augusta, SC (USA)	
	9:700	DOE/R4/10328—T1
FG44-81R410406	Pritchard (C. Lewis), Crossville, TN (USA)	
	9:757	DOE/R4/10406—T1
FG44-81R410412	Upper Sand Mountain Parish, Section, AL (USA)	
	9:326	DOE/R4/10412—T1
FG44-81R410414	Florence, City of, AL (USA)	
	9:744	DOE/R4/10414—T1
FG44-81R410422	Summit Engineering Co., Inc., Spartanburg, SC (USA)	
	9:745	DOE/R4/10422—T1
FG44-81R410432	Wolfe (Steve), Atlanta, GA (USA)	
	9:753	DOE/R4/10432—T1
FG44-81R410442	Talbert, Cox and Associates, Charlotte, NC (USA)	
	9:746	DOE/R4/10442—T1
FG44-81R410444	Morehouse Coll., Atlanta, GA (USA)	
	9:404	DOE/R4/10444—T1
FG44-81R410446	Downing (Benard A., Jr.), Mobile, AL (USA)	
	9:701	DOE/R4/10446—T1
FG44-81R410449	Alternate Energy Associates, Inc., Jonesboro, GA (USA)	
	9:748	DOE/R4/10449—T1
FG44-81R410459	Integrated Energy Systems, Inc., Chapel Hill, NC (USA)	
	9:702	DOE/R4/10459—T1
FG44-81R410461	Osborn (Daniel C.), Huntsville, AL (USA)	
	9:405	DOE/R4/10461—T1
FG44-81R410464	Largo Solar Systems, Inc., Plantation, FL (USA)	
	9:406	DOE/R4/10464—T1
FG44-81R410470	Geo-Centers, Inc., Gainesville, FL (USA)	
	9:758	DOE/R4/10470—T1
FG44-81R410478	Kennedy (Bobby W.), Guntersville, AL (USA)	
	9:314	DOE/R4/10478—T1
FG44-81R410479	Poly Solar Co., Lincolnton, NC (USA)	
	9:407	DOE/R4/10479—T1
FG44-81R410482	Clemson Univ., SC (USA). Dept. of Agricultural Engineering	
	9:733	DOE/R4/10482—T1
FG44-81R410483	South Carolina Wildlife and Marine Resources Dept., Charleston (USA). Marine Resources Div.	
	9:454	DOE/R4/10483—T1

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FG44-81R410486	Mississippi State Univ., Mississippi State (USA)	
	9:703	DOE/R4/10486—T1
FG44-81R410490	Solar Plexus Design, Warne, NC (USA)	
	9:327	DOE/R4/10490—T1
FG44-81R410491	Nolan (Algin H.), Mt. Sterling, KY (USA)	
	9:408	DOE/R4/10491—T2
	Buckhorn Children's Center, KY (USA)	
	9:704	DOE/R4/10491—T1
FG44-81R410493	Nuttle (David A.), Raleigh, NC (USA)	
	9:409	DOE/R4/10493—T1
FG44-81R410494	Sunflower County Library, Indianola, MS (USA)	
	9:410	DOE/R4/10494—T1
FG44-81R410504	Peckworth (Ralph H.), Charlotte, NC (USA)	
	9:705	DOE/R4/10504—T1
FG44-81R410505	Hollingsworth Volunteer Fire Dept., Alto, GA (USA)	
	9:411	DOE/R4/10505—T1
NAS-7-100-766403	United States Export Council for Renewable Energy, Washington, DC	
	9:323	DOE/JPL/766403—83/1
W-31-109-ENG-38	Argonne National Lab., IL (USA)	
	9:60	ANL/FE—83-19
	9:289	DOE/EV—0005/44
	9:290	DOE/EV—0005/45
	ESCOR, Inc., Northfield, IL (USA)	
	9:299	ANL/CNSV-TM—121
	Argonne National Lab., IL (USA)	
	9:483	CONF-830845—6
	9:484	CONF-8310144—3
	9:490	CONF-831111—6
	9:530	CONF-830901—9
	Exide Management and Technology Co., Yardley, PA (USA)	
	9:599	ANL/OEPM—83-6
	Argonne National Lab., IL (USA)	
	9:628	ANL/EES-TM—229
	9:668	ANL—83-34
	9:669	ANL—83-67
	9:740	ANL/CNSV—43
	Governmental Refuse Collection and Disposal Association, Silver Spring, MD (USA)	
	9:741	ANL/CNSV-TM—120-Vol.1
	9:933	Journal of Physical Chemistry 87 NO. 7. 1145-1153 (31 Mar 1983).
	Argonne National Lab., IL (USA)	
	9:1166	ANL/RER—83-1
	9:1308	Analytical Biochemistry 131 NO. 1. vp (May 1983).
	9:1334	Scanning Electron Microscopy 1 377-391 (1982).
	9:1496	Physical Review [Section] D: Particles and Fields 28 NO. 4. 953-964 (15 Aug 1983).
	9:1531	Physical Review [Section] C: Nuclear Physics 28 NO. 2. 885-887 (Aug 1983).
	9:1544	ANL/NDM—80
	9:1553	Physical Review [Section] C: Nuclear Physics 28 NO. 2. 919-920 (Aug 1983).
	9:1665	ANL/FPP/TM—176
	9:1724	ANL—83-76
	9:1725	ANL/NESC—1002R
W-7405-ENG-26	Oak Ridge National Lab., TN (USA)	
	9:1	CONF-8310179—3
	9:85	CONF-821048—6
	9:92	Applied and Environmental Microbiology 45 NO. 3. 743-747 (Mar 1983).
	9:112	CONF-8310180—1
	9:123	CONF-821048—4
	9:124	CONF-8210100—3
	9:125	CONF-8210100—4
	9:126	ORNL/TM—8753
	Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences	
	9:214	CONF-831047—94

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	Oak Ridge Gaseous Diffusion Plant, TN (USA)	
	9:215	K/PS—5024
	Oak Ridge National Lab., TN (USA)	
	9:228	ORNL/TM—8759
	9:264	ORNL/TM—8839
	9:291	ORNL/EIS—154/Vol.4
	9:296	CONF-831025—20
	9:328	CONF-831028—4
	9:348	ORNL/Sub—81-9050/1
	9:352	Applied Physics Letters 43 NO. 7. 666-668 (1 Oct 1983).
	9:438	CONF-831041—13
	9:440	CONF-831041—16
	9:444	ORNL/TM—8657
	9:456	CONF-831041—14
	9:497	NUREG/CR—2000-Vol.2-No.9
	9:498	NUREG/CR—3458
	9:502	NUREG/CR—3500
	9:509	CONF-8310104—3
	Oak Ridge Gaseous Diffusion Plant, TN (USA)	
	9:549	K/PS—5022
	Oak Ridge National Lab., TN (USA)	
	9:563	NUREG/CR—2000-Vol.2-No.8
	9:577	ORNL/TM—8730
	9:674	CONF-8310163—7
	9:707	ORNL/CON—103
	Whittaker Corp., North Hollywood, CA (USA). Shock Hydrodynamics Div.	
	9:708	ORNL/Sub—79-24711/1
	Oak Ridge National Lab., TN (USA)	
	9:709	ORNL/TM—8891
	9:722	CONF-8310200—1
	9:723	CONF-8310202—1-Draft
	9:751	ORNL/CON—119
	9:761	CONF-821049—25
	Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering	
	9:762	CONF-821049—26
	Oak Ridge National Lab., TN (USA)	
	9:763	CONF-831086—6
	Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.	
	9:764	CONF-8106317—1
	Oak Ridge National Lab., TN (USA)	
	9:765	CONF-8310163—5
	9:766	CONF-8310203—1
	9:788	ORNL/TM—8854
	Oak Ridge Y-12 Plant, TN (USA)	
	9:795	Y—2285
	9:796	Y/DV—205
	Oak Ridge National Lab., TN (USA)	
	9:807	ORNL-tr—4957([nd]).
	9:809	CONF-8310183—2
	9:818	
	9:820	
	9:828	CONF-8310163—6
	9:829	CONF-8310163—8
	9:850	Journal of Applied Physics 54 NO. 9. 5004-5013 (Sep 1983).
	9:858	IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics 19 NO.
	9:859	Nuclear Instruments and Methods in Physics Research 208 NO. 1-3. 511-517 (15 Apr 1983).
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	9:870	CONF-831025—18
	9:871	CONF-831025—19
	9:872	CONF-8209193—1
	9:873	CONF-8209193—2
	9:874	CONF-8209193—3
	Oak Ridge Y-12 Plant, TN (USA)	
	9:903	Y/DK—344
	9:934	Journal of Physical Chemistry 87 NO. 7. 1242-1255 (31 Mar 1983).

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	9:937	Geochimica et Cosmochimica Acta 44 NO. 7. 925-931 (1980).
	Oak Ridge National Lab., TN (USA)	
	9:940	ORNL/TM—8956
	Oak Ridge Y-12 Plant, TN (USA)	
	9:987	Y/OA—2724
	9:995	IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics 19 NO.
	9:1001	IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics 19 NO.
	Oak Ridge National Lab., TN (USA)	
	9:1019	CONF-8310163—4
	9:1026	Journal of Nondestructive Evaluation 2 NO. 1. 23-33 (Mar 1981).
	9:1109	DOE/NBM—4001927
	9:1128	DOE/NBM—4002064
	9:1133	CONF-8210209—1
	9:1170	CONF-830707—6
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	9:1202	Journal of the Air Pollution Control Association 32 NO. 11. 1126-1131 (Nov 1982).
	9:1220	ORNL—5983
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	9:1234	IAEA-SR—84/4
	9:1243	CONF-821048—8
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	9:1252	Water Science and Technology 14 45-59 (1982).
	9:1259	IAEA-SR—85/4
	9:1270	ORNL—5942
	Georgia Univ., Athens (USA). Dept. of Physics	
	9:1277	CONF-8209179—1
	Oak Ridge National Lab., TN (USA)	
	9:1299	ORNL/TM—8827
	9:1324	ORNL—6003
	Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.	
	9:1325	ORNL/CSD—123
	Oak Ridge National Lab., TN (USA)	
	9:1336	CONF-811057—4
	9:1337	CONF-821048—5
	9:1338	CONF-821048—7
	9:1339	CONF-821048—9
	9:1340	CONF-8210100—5
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	9:1446	Physical Review Letters 51 NO. 5. 374-377 (1 Aug 1983).
	9:1527	Physical Review Letters 51 NO. 6. 451-454 (8 Aug 1983).
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	9:1545	CONF-821143—8
	9:1546	DOE/ER/04052—63
	Oak Ridge National Lab., TN (USA)	
	9:1551	ORNL/TM—8863
	9:1554	CONF-820979—10
	Washington Univ., St. Louis, MO (USA). Dept. of Chemistry	
	9:1555	CONF-820979—11
	9:1556	CONF-821143—9
	9:1560	Physical Review [Section] C: Nuclear Physics 28 NO. 2. 916-918 (Aug 1983).
	Oak Ridge National Lab., TN (USA)	
	9:1594	ORNL/RSIC—5/V7
	9:1644	ORNL/TM—8833
	9:1645	ORNL/TM—8868
	9:1646	ORNL/TM—8883
	9:1666	CONF-811040—204
	9:1667	CONF-811040—205
	9:1684	ORNL/TM—8767
	9:1696	Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films 1 NO. 3. 1435-144
	9:1718	ORNL/TM—8875
	Oak Ridge Gaseous Diffusion Plant, TN (USA)	
	9:1720	K/D—5443
	9:1730	K/CSD/INF—83/20
	Oak Ridge National Lab., TN (USA)	
	9:1738	ORNL—5819
	Oak Ridge Y-12 Plant, TN (USA)	
	9:1748	Y/CSD/INF—83/2
	9:1749	Y/CSD/INF—83/3
W-7405-ENG-36	**Los Alamos National Lab., NM (USA)**	
	9:79	LA—9845-MS
	9:201	LA—9678-PR
	9:202	LA—9783-PR
	9:251	LA—9793-PR
	9:252	LA-UR—83-3024
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CONF-8105117-	(Small wind turbine systems conference, Boulder, CO, USA, 12-14 May 1981)			
	See N-8323722			9:469
	See N-8323728			9:470
CONF-8105139-	(ASM metallurgical technology of uranium and uranium alloys seminar, Gatlinburg, TN, USA, 26-28 May 1981)			
14	*See* Y/DV-205	DE84001182	MN -25	9:796
CONF-8106218-	(7. all-union seminar on linear accelerators, Kharkov, Ukrainian SSR, 2-4 Jun 1981)			
	See KFTI-81-52	DE84780033	MN -34D	9:1053
CONF-8106317-	(Symposium on free boundary problems, Montecatini, Italy, 18-26 Jun 1981)			
1	NTIS, PC A02/MF A01	DE83015517	MN -32	9:764
CONF-810943-	(Conference on chemistry of materials at high temperatures, Harwell, Oxfordshire, UK, 7-10 Sep 1981)			
	High Temp. - High Pressures, 14: No. 5, 581-591(1982)			9:968
CONF-8109202-	(1. international symposium on coal, Ixtapa, Mexico, 7-9 Sep 1981)			
	See ICTIS/M-0165			9:48
CONF-8109239-	(Regional conference: state measures against hazards in the industrial society, Wiesbaden, F.R. Germany, 23-25 Sep 1981)			
1	*See* WBZ-P-82-5	DE83751323	MN -2	9:637
CONF-811040-	(9. symposium on engineering problems of fusion research, Chicago, IL, USA, 26-29 Oct 1981)			
204	NTIS, PC A02/MF A01; 1	DE84002061	MN -20c	9:1666
205	NTIS, PC A02/MF A01; 1	DE84001999	MN -20a	9:1667
CONF-811046-	(Meeting and workshop on fusion reactor design and technology, Tokyo, Japan, 5-16 Oct 1981)			
Vol.1	Vienna, Austria; International Atomic Energy Agency (1983).			9:1702
Vol.2	Vienna, Austria; International Atomic Energy Agency (1983).			9:1703
CONF-811048-	(International symposium on indoor air pollution, health and energy conservation, Amherst, MA, USA, 13-16 Oct 1981)			
	Environ. Int., 8: No. 1-6, 525-531(1982)			9:633
	Environ. Int., 8: No. 1-6, 419-433(1982)			9:1204
	Environ. Int., 8: No. 1-6, 435-445(1982)			9:1205
	Environ. Int., 8: No. 1-6, 447-452(1982)			9:1206
	Environ. Int., 8: No. 1-6, 461-471(1982)			9:1207
CONF-811057-	(EPA/HERL international symposium on health effects of tumor promotion, Cincinnati, OH, USA, 13-15 Oct 1981)			
4	NTIS, PC A02/MF A01; 1	DE84001938	MN -48	9:1336
CONF-820369-	(International workshop on physics and engineering in medical imaging, Pacific Grove, CA, USA, 15-18 Mar 1982)			
2	*See* LBL-14316		MN -48	9:1297
CONF-8203150-	(Seminar on plastic in the 1980's, Pretoria, South Africa, 1 Mar 1982)			
	See N-8322425			9:821
	See N-8322427			9:822
CONF-8205231-	(Radiation carcinogenesis conference, Bethesda, MD, USA, 24-26 May 1982)			
1	*See* BNL-33776	DE84001652	MN -48	9:1598
CONF-820618-	(International conference on plasma physics, Goeteborg, Sweden, 7-21 Jun 1982)			
13	*See* GKSS-82/E/52	DE83751320	MN -20	9:1077
CONF-820799-	(Summer school in ESA solar energy 1982: resources, technologies, potential, Igls, Austria, 28 Jul-6 Aug 1982)			
	See N-8323746			9:316
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	See N-8323767			9:656
	See N-8323765			9:662
	See N-8323768			9:663
	See N-8323770			9:664
CONF-8207100-	(Workshop on astrophysical radiation hydrodynamics, Munich, F.R. Germany, 1 Jul 1982)			
1	*See* UCRL-89811	DE84000185	MN -34B	9:1417
CONF-820807-	(16. annual meeting of the Microbeam Analysis Society, Washington, DC, USA, 9-13 Aug 1982)			
5	*See* BNL-33727	DE84001462	MN -11	9:1168
CONF-820839-	(International conference on X-ray and VUV synchrotron radiation instrumentation, Hamburg, F.R. Germany, 9-13 Aug 1982)			
	Nucl. Instrum. Methods Phys. Res., 208: No. 1-3, 511-517(15 Apr 1983)			9:859
	Nucl. Instrum. Methods Phys. Res., 208: No. 1-3, 815-818(15 Apr 1983)			9:1449
	Nucl. Instrum. Methods Phys. Res., 208: No. 1-3, 549-554(15 Apr 1983)			9:1596
CONF-8208101-	(4. international symposium on radiopharmaceutical chemistry, Juelich, F.R. Germany, 23-27 Aug 1982)			
	J. Labelled Compd. Radiopharm., 19: No. 11-12, 1282-1283(Nov-Dec 1982)			9:960
CONF-8208160-	(Annual transportation conference, Pretoria, South Africa, 9-13 Aug 1982)			
	See N-8323212			9:719
	See N-8323215			9:720
	See N-8323216			9:721
CONF-820931-	(8. symposium on microdosimetry, Juelich, F.R. Germany, 27 Sep-1 Oct 1982)			
14	*See* BNL-33782	DE84001692	MN -48	9:1311
CONF-820979-	(International conference on nucleus-nucleus collisions, East Lansing, MI, USA, 27 Sep-1 Oct 1982)			
10	NTIS, PC A02/MF A01; 1	DE84001943	MN -34C	9:1554
11	NTIS, PC A02/MF A01	DE84002070	MN -34C	9:1555
CONF-8209179-	(2. National Foundation for Cancer Research symposium on protective agents in humans and experimental cancers, Uxbridge, UK, 1-3 Sep 1982)			
1	NTIS, PC A03/MF A01; 1	DE84000206	MN -48	9:1277
CONF-8209193-	(9. International School of Quantum Electronics course on analytical laser spectroscopy, Erice, Italy, 23 Sep-3 Oct 1982)			
1	NTIS, PC A02/MF A01; 1	DE84001977	MN -34A	9:872
2	NTIS, PC A02/MF A01	DE84001975	MN -34A	9:873
3	NTIS, PC A02/MF A01	DE84001942	MN -34A	9:874
CONF-821018-	(IEEE/ASME/ASCE joint power generation conference, Denver, CO, USA, 17-21 Oct 1982)			
	Am. Soc. Mech. Eng., [Pap.], 82-IPGC-GT-2Z: 5(1982)			9:191
CONF-821048-	(5. Life Sciences symposium on synthetic fossil fuel technologies, Gatlinburg, TN, USA, 24-27 Oct 1982)			
4	NTIS, PC A02/MF A01	DE84001944	MN -11	9:123
5	NTIS, PC A03/MF A01	DE84002063	MN -48	9:1337
6	NTIS, PC A04/MF A01	DE84002545	MN -90i	9:85
7	NTIS, PC A02/MF A01; 1	DE84002068	MN -11	9:1338
8	NTIS, PC A03/MF A01	DE84001998	MN -11	9:1243
9	NTIS, PC A03/MF A01	DE84001953	MN -41	9:1339
CONF-821049-	(TMS/AIME fall meeting(Radiation damage analysis for fusion reactors), St. Louis, MO, USA, 24-28 Oct 1982)			
25	NTIS, PC A03/MF A01; 1	DE84001985	MN -25	9:761
26	NTIS, PC A02/MF A01	DE84001993	MN -25	9:762
CONF-821053-	(Workshop on standardization of methods for measuring migration of radionuclides in geomedia, Berlin, F.R. Germany, 25-29 Oct 1982)			
6	*See* PNL-SA-10836	DE84002591	MN -70	9:287
CONF-8210100-	(7. international symposium on polynuclear aromatic hydrocarbons, Columbus, OH, USA, 26-28 Oct 1982)			
3	NTIS, PC A02/MF A01	DE84001940	MN -90i	9:124
4	NTIS, PC A02/MF A01	DE84001989	MN -90i	9:125
5	NTIS, PC A02/MF A01	DE84001946	MN -48	9:1340
CONF-8210111-	(Numerical astrophysics meeting (in honor of Jim Wilson's 60th birthday), Urbana, IL, USA, 21-23 Oct 1982)			
3	*See* UCRL-88720	DE84002011	MN -34B	9:1416
CONF-8210169-	(18. congress of the French Society of Ergonomy on imaging and applications, Rocquencourt, France, 11-15 Oct 1982)			
1	*See* CEA-CONF-6626	DE83703737	MN -41	9:529
CONF-8210208-	(Workshop on current trends in food web theory, Fontana Village, NC, USA, 25-27 Oct 1982)			
Summs.	*See* ORNL-5983	DE84002260	MN -11	9:1220
CONF-8210209-	(Guarded hot plate seminar, Quebec, Canada, 7-8 Oct 1982)			
1	NTIS, PC A03/MF A01	DE84001986	MN -25	9:1133
CONF-821143-	(High angular momentum properties of nuclei conference, Oak Ridge, TN, USA, 2-4 Nov 1982)			
8	NTIS, PC A02/MF A01	DE84001388	MN -34C	9:1545
9	NTIS, PC A02/MF A01	DE84001392	MN -34C	9:1556

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CONF-821188-	(4. ESTEC spacecraft power conditioning seminar, Noordwijk, Netherlands, 9-11 Nov 1982)			
	See N-8321006			9:603
	See N-8321008			9:604
	See N-8321010			9:605
	See N-8321020			9:606
	See N-8321021			9:607
	See N-8321022			9:608
	See N-8321023			9:609
	See N-8321024			9:610
	See N-8321025			9:611
CONF-821199-	(Conference on subsidence due to fluid withdrawal, Checotah, OK, USA, 14-17 Nov 1982)			
	NTIS MF A01; 2	DE84001028	STD -92a	9:1389
CONF-830140-	(18. Rencontre de Moriond conference, La Plagne, France, 23-29 Jan 1983)			
6	*See* BONN-HE-83-4	DE83751313	MN -34D	9:1462
CONF-830301-	(ASME-JSME thermal engineering joint conference, Honolulu, HI, USA, 20-24 Mar 1983)			
21	*See* N-8322542			9:1453
CONF-830309-	(28. ASME international gas turbine conference, Phoenix, AZ, USA, 27-31 Mar 1983)			
	Am. Soc. Mech. Eng., [Pap.], 83-GT-108: 10(1983)			9:56
CONF-830311-	(Particle accelerator conference, Santa Fe, NM, USA, 21-23 Mar 1983)			
190	*See* BNL-32768	DE84001456	MN -28	9:1048
CONF-830314-	(2. national conference on high power microwave technology, Adelphi, MD, USA, 1-3 Mar 1983)			
6	*See* UCRL-88705	DE84002001	MN -28	9:1013
CONF-830339-	(Theoretical symposium on intense medium energy sources of strangeness, Santa Cruz, CA, USA, 19-21 Mar 1983)			
	American Institute of Physics, 335 East 45th St., New York, NY 10017			9:1460
CONF-830353-	(Meeting on the impact of specialized processors in elementary particle physics, Padua, Italy, 23-25 Mar 1983)			
3	*See* BONN-HE-83-6	DE83751325	MN -80	9:513
CONF-830406-	(5. topical meeting on technology of fusion energy, Knoxville, TN, USA, 26-28 Apr 1983)			
111	*See* UCRL-88995	DE83018185	MN -21	9:1693
CONF-830450-	(IAEA/WHO symposium on biological effects of low level radiation, Venice, Italy, 11-15 Apr 1983)			
3	*See* BNL-33788	DE84001693	MN -48	9:1599
CONF-830451-	(American Ceramic Society annual meeting, Chicago, IL, USA, 25-28 Apr 1983)			
25	*See* DP-MS-82-97	DE84001754	MN -70	9:238
CONF-830455-	(Yamada conference on muon spin rotation and associated problems, Shimoda, Japan, 18-27 Apr 1983)			
9	*See* BNL-33793	DE84001679	MN -34D	9:1461
CONF-8304128-	(25. anniversary meeting of the Nuclear Energy Agency of the OECD, Lyon, France, 21 Apr 1983)			
1-Trans	*See* RISLEY-Trans-4756	DE83902752	MN -79	9:494
CONF-8304129-	(8. AIAA conference on aerodynamic decelerator and balloon technology, Hyannis, MA, USA, 2-4 Apr 1983)			
3	*See* SAND-83-1636C	DE84002382	MN -13	9:984
CONF-8304130-	(ANS midwest regional student conference on meeting the nuclear challenge, Champaign, IL, USA, 7-9 Apr 1983)			
Abstr.	*See* DOE/ER/75094-2	DE84001391	MN -2	9:481
CONF-8304134-	(ANS eastern regional student conference, Charlottesville, VA, USA, 22-23 Apr 1983)			
Abstr.	*See* DOE/ER/75094-3	DE84001384	MN -2	9:507
CONF-830508-	(163. Electrochemical Society meeting, San Francisco, CA, USA, 8-13 May 1983)			
4-Rev.	*See* LBL-15491-Rev.	DE84000384	MN -25	9:837
CONF-830528-	(7. international symposium on packaging and transportation of radioactive materials, New Orleans, LA, USA, 15-20 May 1983)			
61	*See* Y/OA-2724	DE84002418	MN -71	9:987
CONF-8305110-	(Fronts, interfaces and patterns conference, Los Alamos, NM, USA, 2-6 May 1983)			
4	*See* LA-UR-83-2886	DE84001175	MN -32	9:965
5	*See* LA-UR-83-3049	DE84001730	MN -32	9:1737
CONF-8305139-	(Conference on fundamentals of adsorption, Bavaria, F.R. Germany, 1 May 1983)			
1	*See* LA-UR-83-2848	DE84001016	MN -32	9:1604
CONF-8305143-	(3. international conference on graphite intercalation compounds, Pont-a-Moussan, France, 23-27 May 1983)			
1	*See* LBL-16615	DE84001863	MN -25	9:840
CONF-830607-	(American Society of Mechanical Engineers pressure vessel and piping conference, Portland, OR, USA, 19-24 Jun 1983)			
27	NTIS, PC A02/MF A01; 1	DE84001851	MN -79k	9:489
CONF-830617-	(76. annual meeting of the Air Pollution Control Association, Atlanta, GA, USA, 19-24 Jun 1983)			
14	*See* LBL-15839	DE84001820	MN -95d	9:1191

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CONF-830631-	(6. biennial wind energy conference, Minneapolis, MN, USA, 1-3 Jun 1983)			
11	*See* DOE/NASA/20320-52	DE84001909	MN -60	9:466
12	*See* DOE/NASA/20320-51	DE84002100	MN -60	9:465
CONF-830650-	(FRG/US workshop on size reduction and decontamination facilities, Karlsruhe, F.R. Germany, 27-30 Jun 1983)			
4	*See* PNL-SA-11416	DE84002592	MN -70	9:268
CONF-830666-	(6. international conference on laser spectroscopy, Interlaken, Switzerland, 27 Jun-1 Jul 1983)			
4	*See* LBL-16406	DE84001854	MN -34A	9:839
CONF-830674-	(6. international Balaton topical conference on high energy nuclear physics, Balatonfured, Hungary, 6-11 Jun 1983)			
5	*See* DOE/ER/40048-16	DE84001103	MN -34D	9:1491
CONF-830689-	(14. international symposium on multiparticle dynamics, Lake Tahoe, NV, USA, 22-27 Jun 1983)			
8	*See* SLAC-PUB-3168	DE84001444	MN -28	9:1513
9	*See* SLAC-PUB-3181	DE84002374	MN -28	9:1494
CONF-830697-	(International conference on nonlinear electrodynamics in biological systems, Loma Linda, CA, USA, 5-10 Jun 1983)			
3	*See* LA-UR-83-2252	DE83015219	MN -48	9:1279
CONF-8306110-	(2. Pisa meeting on advanced detectors, Castiglione della Pescaia, Italy, 2-8 Jun 1983)			
3	*See* BNL-33692	DE84001460	MN -37	9:1127
CONF-8306123-	(27. annual meeting of the American Association of Cost Engineers, Philadelphia, PA, USA, 26-29 Jun 1983) American Association of Cost Engineers, 308 Monongahela Building, Morgantown, WV 26505-5468			9:969
CONF-8306125-	(4. Adriatic meeting on particle physics, Dubrovnik, Yugoslavia, 6-16 Jun 1983)			
2	*See* BNL-33648	DE84001473	MN -34D	9:1499
CONF-8306131-	(Asia Pacific Physics conference, Singapore, Singapore, 12-18 Jun 1983)			
1	NTIS, PC A02/MF A01	DE84001293	MN -34D	9:1506
CONF-8306132-	(Interagency manufactiring operations group meeting, Denver, CO, USA, 15 Jun 1983)			
1	*See* UCRL-89739	DE84001430	MN -38	9:986
CONF-8306138-	(Fatigue and corrosion fatigue meeting, Montreal, Canada, 1-3 Jun 1983)			
1	*See* DOE/ER/03459-18	DE84001373	MN -25	9:767
CONF-8306139-	(Time projection chamber workshop, Vancouver, Canada, 23-25 Jun 1983)			
1	*See* LA-UR-83-2839	DE84001033	MN -34C	9:1115
CONF-830702-	(21. ASME/AIChE national heat transfer conference, Seattle, WA, USA, 24-28 Jul 1983)			
27	*See* EGG-M-08883	DE84000563	MN -78	9:535
28	*See* EGG-M-04683	DE84001048	MN -78	9:532
CONF-830707-	(Summer computer simulation conference, Vancouver, Canada, 11-13 Jul 1983)			
4	*See* EGG-M-26782	DE84001051	MN -78	9:488
5	*See* EGG-M-26282	DE84001050	MN -80	9:508
6	NTIS, PC A02/MF A01	DE83015693	MN -41	9:1170
CONF-830710-	(7. international conference of radiation research, Amsterdam, Netherlands, 3-8 Jul 1983)			
10	NTIS, PC A02/MF A01	DE84001511	MN -48	9:1312
CONF-830765-	(6. computer security conference, Denver, CO, USA, 25-28 Jul 1983)			
2	*See* Y/CSD/INF-83/2	DE84001585	MN -32	9:1748
CONF-830782-	(11. L. H. Gray conference on cellular repair of radiation damage - mechanisms and modifying agents, Glasgow, UK, 18-22 Jul 1983)			
2	*See* LBL-16549	DE84001325	MN -48	9:1321
CONF-830797-	(Workshop on high energy transients, Santa Cruz, CA, USA, 11-22 Jul 1983)			
2	*See* LA-UR-83-2744	DE84001312	MN -34B	9:1411
5	*See* LA-UR-83-2657	DE84001334	MN -34B	9:1410
6	*See* UCRL-89892	DE84001450	MN -34B	9:1418
CONF-830798-	(3. LAMPF II workshop, Los Alamos, NM, USA, 18-29 Jul 1983)			
4	*See* LBL-16596	DE83018119	MN -34A	9:1469
5	*See* DOE/ER/40048-17	DE84001173	MN -34C	9:1492
CONF-8307103-	(International symposium on wavefunctions and mechanisms from electron scattering processes, Castelgandolfo, Italy, 24-26 Jul 1983)			
1	*See* UCRL-89447	DE84001401	MN -34A	9:1439
2	*See* UCRL-89451	DE84001767	MN -4	9:925
CONF-830805-	(7. international conference on structural mechanics in reactor technology, Chicago, IL, USA, 22-26 Aug 1983)			
56	*See* EGG-M-16182	DE84000891	MN -78	9:537
57	*See* EGG-M-17582	DE84000836	MN -78	9:541
58	*See* EGG-M-14582	DE84000367	MN -80	9:536
63	*See* HEDL-SA-2757-FP	DE84001480	MN -79b	9:491
CONF-830808-	(International solvent extraction conference, Denver, CO, USA, 26 Aug-2 Sep 1983)			
13	*See* LBL-16561	DE84001841	MN -4	9:919

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CONF-830811-	(Conference on quantitative NDE, Santa Cruz, CA, USA, 7-12 Aug 1983)			
17	*See* UCRL-89922	DE84001777	MN -25	9:1025
CONF-830815-	(18. annual Microbeam Analysis Society conference, Phoenix, AZ, USA, 8-12 Aug 1983)			
12	*See* RHO-BW-SA-295-P	DE84001111	MN -70	9:1400
CONF-830816-	(International meeting on light-water reactor severe accident evaluation, Cambridge, MA, USA, 28 Aug-1 Sep 1983)			
39	*See* EGG-M-16383	DE84000888	MN -78	9:539
41	*See* EGG-M-08483	DE84000892	MN -78	9:534
44	*See* EGG-M-08283	DE84000896	MN -78	9:533
45	*See* EGG-M-16283	DE84000901	MN -78	9:538
46	*See* EGG-M-16483	DE84000890	MN -78	9:540
CONF-830822-	(12. international conference on high energy accelerators, Batavia, IL, USA, 11-16 Aug 1983)			
33	*See* SLAC-PUB-3149	DE84001601	MN -28	9:1055
34	*See* SLAC-PUB-3170	DE84001606	MN -28	9:1060
35	*See* SLAC-PUB-3172	DE84001608	MN -28	9:1104
36	*See* BNL-33698	DE84001471	MN -28	9:1049
37	*See* LBL-16539	DE84001814	MN -28	9:1083
38	*See* SLAC-PUB-3183	DE84001925	MN -28	9:1062
39	*See* SLAC-PUB-3186	DE84001924	MN -28	9:1063
CONF-830833-	(International conference on nuclear physics, Florence, Italy, 29 Aug-3 Sep 1983)			
3	*See* DOE/ER/40048-74-L3	DE84001501	MN -34D	9:1503
CONF-830839-	(Solar world congress, Perth, Australia, 15-19 Aug 1983)			
2	*See* SERI/TP-211-2048	DE83012131	STD -63	9:351
CONF-830841-	(Cryogenic engineering conference and international cryogenic materials conference, Colorado Springs, CO, USA, 15-19 Aug 1983)			
26	*See* LA-UR-83-2594	DE84000487	MN -20b	9:594
27	*See* SLAC-PUB-3169	DE84002552	MN -28	9:1084
CONF-830845-	(Environmental degradation of materials in nuclear power systems-water reactors, Myrtle Beach, SC, USA, 22-24 Aug 1983)			
5	*See* SAND-83-1714C	DE84000355	MN -78	9:482
6	NTIS, PC A03/MF A01	DE84000613	MN -78	9:483
CONF-830847-	(Energy resource management '83, San Francisco, CA, USA, 23-27 Aug 1983)			
5	*See* PNL-SA-11459	DE84002586	MN -2	9:521
CONF-830862-	(10. international conference on few-body problems in physics, Karlsruhe, F.R. Germany, 21-27 Aug 1983)			
8	*See* LA-UR-83-2653	DE84001333	MN -34C	9:1524
CONF-830874-	(27. annual international technical symposium on high speed photography, videography and photonics, San Diego, CA, USA, 21-26 Aug 1983)			
29	*See* LA-UR-83-2665	DE84001338	MN -48	9:889
CONF-8308106-	(5. annual participants information meeting of DOE low level waste management program, Denver, CO, USA, 30 Aug-1 Sep 1983)			
18	*See* PNL-SA-11576	DE84000680	MN -70B	9:288
21	*See* DP-MS-83-90	DE84001536	MN -70B	9:240
22	*See* LA-UR-83-3024	DE84001737	MN -70B	9:252
CONF-8308110-	(6. international congress on photosynthesis, Brussels, Belgium, 1-6 Aug 1983)			
6	*See* BNL-33729	DE84001897	MN -11	9:1276
CONF-8308114-	(Laser-based ultrasensitive spectroscopy and detection V conference, San Diego, CA, USA, 23 Aug 1983)			
2	*See* PNL-SA-11189	DE84000677	MN -34	9:901
CONF-8308126-	(NRC research annual review meeting of nuclear waste management research on geochemistry of HLW disposal, Reston, VA, USA, 30 Aug-1 Sep 1983)			
2	*See* BNL-NUREG-33579	DE84001458	MN -70	9:230
CONF-8308134-	(3. international conference on nuclear war, Erice, Italy, 16-24 Aug 1983)			
1	*See* UCRL-89907	DE84002007	MN -11	9:1157
2	*See* UCRL-89956	DE84002716	MN -11	9:1158
3	*See* UCRL-89770	DE84002729	MN -11	9:1156
4	*See* UCRL-89957	DE84002717	MN -11	9:1159
CONF-8308135-	(SHARE 61 conference, New York, NY, USA, 21-26 Aug 1983)			
1	*See* SLAC-PUB-3207	DE84001490	MN -28	9:1743
CONF-8308137-	(CACGP symposium on tropospheric chemistry, Oxford, England, 28 Aug-3 Sep 1983)			
1	*See* BNL-33726	DE84001898	MN -11	9:1167
CONF-8308138-	(Energy Information Administration symposium on petroleum supply information, Arlington, VA, USA, 24 Aug 1983)			
	See DOE/EIA-0425	DE84001387	MN -98B	9:164
CONF-830901-	(Anticipated and abnormal plant transients in light water reactors conference, Jackson, WY, USA, 26-29 Sep 1983)			
9	NTIS, PC A03/MF A01; 1	DE84000601	MN -78	9:530
12	*See* LA-UR-83-2719	DE84001327	MN -78	9:552
13	*See* LA-UR-83-2753	DE84001315	MN -78	9:553
14	*See* LA-UR-83-2780	DE84001303	MN -78	9:554
15	*See* LA-UR-83-2816	DE84001032	MN -78	9:557

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16	*See* LA-UR-83-2806	DE84001031	MN -78	9:556
17	*See* LA-UR-83-2786	DE84001316	MN -78	9:555
18	*See* EGG-M-18983	DE84001648	MN -78	9:542
CONF-830905-	(Joint power generation conference, Indianapolis, IN, USA, 25-29 Sep 1983)			
10	*See* HEDL-SA-2857-FP	DE84001495	MN -79k	9:492
CONF-830910-	(3. national conference on synchrotron radiation instrumentation, Upton, NY, USA, 12-14 Sep 1983)			
2	*See* BNL-33703	DE84001451	MN -37	9:1105
4	*See* BNL-33724	DE84001903	MN -37	9:1106
5	*See* SLAC-PUB-3204	DE84001928	MN -28	9:1085
CONF-830911-	(5. international conference on high power particle beams, San Francisco, CA, USA, 12-14 Sep 1983)			
31	*See* LA-UR-83-2622	DE84001344	MN -34	9:1031
32	*See* LA-UR-83-2669	DE84001337	MN -34	9:1078
33	*See* UCRL-89881	DE84001421	MN -28	9:1064
CONF-830927-	(7. international conference on crystal growth, Stuttgart, F.R. Germany, 12-26 Sep 1983)			
3	*See* K/PS-5024	DE84001872	MN -22	9:215
CONF-830928-	(9. ASME biennial conference on mechanical vibration and noise, Dearborn, MI, USA, 12-14 Sep 1983)			
2	*See* BDX-613-294	DE84002421	MN -38	9:970
CONF-830942-	(3. topical meeting on fusion reactor materials, Albuquerque, NM, USA, 19-23 Sep 1983)			
47	*See* PNL-SA-11364	DE84000679	MN -20c	9:790
49	*See* DOE/ER/10107-21	DE84001276	MN -20c	9:768
50	*See* LA-UR-83-2628	DE84001343	MN -20c	9:1680
51	NTIS MF A01; 2	DE84001646	MN -20c	9:1668
52	*See* PNL-SA-11365	DE84001416	MN -20c	9:791
53	*See* PNL-SA-11321	DE84000903	MN -20c	9:789
54	*See* HEDL-SA-2883	DE84001487	MN -20c	9:1673
55	*See* HEDL-SA-2910	DE84001469	MN -20c	9:1675
56	*See* HEDL-SA-2896	DE84001474	MN -20c	9:1674
57	*See* LA-UR-83-2972	DE84001711	MN -20f	9:1682
CONF-830950-	(2. international statistical database management workshop, Los Altos, CA, USA, 27-29 Sep 1983)			
1	*See* PNL-SA-11513	DE84001412	MN -32	9:1753
2	*See* PNL-SA-11512	DE84001414	MN -32	9:1723
CONF-830969-	(12. international conference on solid state nuclear track detectors, Acapulco, Mexico, 4-10 Sep 1983)			
2	*See* UCRL-88970	DE84001422	MN -21	9:1692
3	*See* HEDL-SA-2859-FP	DE84001466	MN -37	9:1111
5	*See* HEDL-SA-2847-FP	DE84001494	MN -37	9:1110
6	*See* HEDL-SA-2864-FP	DE84001477	MN -41	9:1112
CONF-830970-	(International symposium on highly excited states and nuclear structure, Orsay, France, 5-8 Sep 1983)			
2	*See* DOE/ER/40048-78-L3	DE84001544	MN -34C	9:1563
CONF-830971-	(8. international conference on magnet technology and exhibition, Grenoble, France, 5-9 Sep 1983)			
5	*See* LBL-15899	DE84001100	MN -38	9:1139
6	*See* LBL-15865	DE84001101	MN -38	9:1138
CONF-830990-	(Solar thermal research workshop, Atlanta, GA, USA, 7-8 Sep 1983)			
1	*See* SERI/TP-253-2106	DE84000015	MN -62e	9:427
CONF-8309103-	(9. international vacuum congress and 5. international conference on solid surfaces, Madrid, Spain, 26 Sep-1 Oct 1983)			
10	*See* SLAC-PUB-3213	DE84001491	MN -28	9:1607
CONF-8309150-	(International workshop on stable isotopes in the assessment of natural and anthropogenic sulfur in the environment, Pushchino, USSR, 9-16 Sep 1983)			
2	*See* BNL-33733	DE84001455	MN -11	9:1169
CONF-8309156-	(7. meeting of the international collaboration on advanced neutron sources, Ontario, Canada, 12-16 Sep 1983)			
6	*See* LA-UR-83-2736	DE84001308	MN -28	9:1080
7	*See* LA-UR-83-2693	DE84001318	MN -28	9:1079
CONF-8309164-	(Molecular and cellular approaches to understanding mechanisms of toxicity conference, Boston, MA, USA, 1-2 Sep 1983)			
1	*See* LA-UR-83-2677	DE84001322	MN -48	9:1346
CONF-8309165-	(3. annual computer users conference of the National Center for Atmospheric Research, Boulder, CO, USA, 20-21 Sep 1983)			
1	*See* LA-UR-83-2678	DE84001068	MN -32	9:1736
CONF-8309166-	(2. international conference on carbonaceous particles in the atmosphere, Linz, Austria, 11-14 Sep 1983)			
2	*See* LBL-16108	DE84000899	MN -11	9:1195
3	*See* LBL-16105	DE84001091	MN -11	9:1193
4	*See* LBL-16104	DE84000730	MN -11	9:1192
5	*See* LBL-16107	DE84001078	MN -11	9:1194
CONF-8309167-	(Annual meeting of Association for Aerosol Research, Munich, F.R. Germany, 13-16 Sep 1983)			
1	*See* DOE/EV/03490-2338	DE84000887	MN -48	9:1343
2	*See* DOE/EV/03490-2335	DE84001135	MN -48	9:1342

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CONF-8309170-	(Symposium on the use of nonstandard subsized specimens for irradiated testing, Albuquerque, NM, USA, 23 Sep 1983)			
2	*See* HEDL-SA-2907-FP	DE84001500	MN -25	9:772
5	*See* DOE/ER/10107-22	DE84001275	MN -25	9:1020
CONF-8309171-	(33. Canadian Chemical Engineering Society meeting, Toronto, Canada, 16 Sep 1983)			
1	*See* PNL-SA-11640	DE84002590	MN -61	9:302
CONF-8309172-	(IAU symposium on observational tests of stellar evolution theory, Geneva, Switzerland, 12-16 Sep 1983)			
2	*See* LA-UR-83-2930	DE84001720	MN -34B	9:1412
3	*See* LA-UR-83-2969	DE84001715	MN -34B	9:1413
CONF-8309173-	(NATO Advanced Study Institute conference on physics and chemistry of electrons and related ions in condensed matter, Cambridge, UK, 4-16 Sep 1983)			
1	*See* LBL-16634	DE84001823	MN -4	9:921
CONF-8309174-	(5. international seminar applications of science in examination of works of art, Boston, MA, USA, 7-9 Sep 1983)			
1	*See* BNL-33786	DE84001651	MN -4	9:957
CONF-8309177-	(4. Air Infiltration Centre conference on air infiltration reduction in existing buildings, Elm, Switzerland, 26-28 Sep 1983)			
1	*See* LBL-16221	DE84000478	MN -95d	9:706
CONF-8309178-	(Conference on transport of proteins, ions and electrons through mitochondrial membranes, University College Cork, Ireland, 27-30 Sep 1983)			
1	*See* LBL-16446	DE84001329	MN -48	9:1280
CONF-831015-	(Nuclear science symposium, San Francisco, CA, USA, 19-21 Oct 1983)			
3	*See* SAND-83-0658C	DE84000465	MN -80	9:486
4	*See* UCRL-89935	DE84001779	MN -38	9:1146
5	*See* LA-UR-83-2942	DE84001716	MN -15	9:1118
6	*See* LA-UR-83-2958	DE84001713	MN -41	9:1119
7	*See* LA-UR-83-2909	DE84001868	MN -15	9:1116
8	*See* LA-UR-83-2941	DE84001717	MN -15	9:1117
9	*See* LA-UR-83-2959	DE84001714	MN -41	9:1120
10	*See* LA-UR-83-3009	DE84001703	MN -38	9:1121
11	*See* LA-UR-83-3042	DE84001733	MN -37	9:1134
12	*See* LA-UR-83-3060	DE84001732	MN -37	9:1135
13	*See* BNL-33736	DE84002579	MN -37	9:1107
CONF-831025-	(26. ORNL-DOE conference on analytical chemistry in energy technology, Knoxville, TN, USA, 11-13 Oct 1983)			
3	*See* PNL-SA-11435	DE84001040	MN -4	9:902
5	*See* DP-MS-83-40	DE84001411	MN -38	9:877
6	*See* DP-MS-83-67	DE84001417	MN -38	9:879
7	*See* DP-MS-83-37	DE84001419	MN -38	9:876
8	*See* DP-MS-83-51	DE84001418	MN -4	9:878
9	*See* HEDL-SA-2920	DE84001465	MN -79a	9:525
11	*See* K/PS-5022	DE84001783	MN -78	9:549
12	*See* UCRL-89593	DE84001788	MN -37	9:1145
13	*See* UCRL-89262	DE84001785	MN -37	9:1144
14	*See* LA-UR-83-2905	DE84001869	MN -4	9:890
15	*See* LA-UR-83-2970	DE84001710	MN -4	9:891
16	*See* LA-UR-83-3010	DE84001702	MN -34A	9:892
17	NTIS, PC A02/MF A01	DE84001757	MN -4	9:869
18	NTIS, PC A02/MF A01	DE84001988	MN -25	9:870
19	NTIS, PC A02/MF A01	DE84001967	MN -4	9:871
20	NTIS, PC A02/MF A01	DE84001936	MN -4	9:296
CONF-831028-	(Photovoltaic solar energy conference, Athens, Greece, 17-22 Oct 1983)			
1	*See* SAND-83-2219C	DE84001641	MN -63c	9:350
2	*See* SAND-83-1019C	DE84001538	MN -63	9:357
3	*See* SAND-83-2228C	DE84001537	MN -63	9:358
4	NTIS, PC A02/MF A01; 1	DE84002059	MN -63b	9:328
CONF-831032-	(Seminar on the environmental transfer to man of radionuclides released from nuclear installations, Brussels, Belgium, 17-21 Oct 1983)			
1	*See* IAEA-SR-84/4	DE84001965	MN -41	9:1234
2	*See* IAEA-SR-85/4	DE84001958	MN -11	9:1259
3	*See* UCRL-89766	DE84002721	MN -11	9:1235
CONF-831041-	(1983 Geothermal Resources Council's annual meeting, Portland, OR, USA, 24-27 Oct 1983)			
11	*See* LBL-16100	DE84000939	MN -66a	9:433
12	*See* LBL-16207	DE84001099	MN -66b	9:449
13	NTIS, PC A02/MF A01	DE84001991	MN -66a	9:438
14	NTIS, PC A02/MF A01; 1	DE84001990	MN -66	9:456
15	*See* LBL-16218	DE84001817	MN -66a	9:443
16	NTIS, PC A02/MF A01	DE84001974	MN -66e	9:440
CONF-831043-	(Seminar on transport of radioactive material by post, Vienna, Austria, 24-27 Oct 1983)			
5	*See* SAND-83-1965C	DE84001642	MN -78	9:579
CONF-831047-	(American Nuclear Society winter meeting, San Francisco, CA, USA, 30 Oct-4 Nov 1983)			
89	NTIS, PC A02/MF A01; 1	DE84001959	MN -41	9:1359
93	NTIS, PC A02/MF A01	DE84001978	MN -11	9:1171
94	NTIS, PC A02/MF A01	DE84002069	MN -4	9:214

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CONF-831086-	(Electrochemical Society fall meeting, Washington, DC, USA, 9-14 Oct 1983)			
6	NTIS, PC A02/MF A01	DE84001994	MN -4	9:763
CONF-831093-	(Wind expo '83 and AWEA national conference, San Francisco, CA, USA, 16-19 Oct 1983)			
1	*See* DOE/NASA/20320-53	DE84001931	STD -60	9:467
2	NTIS, PC A02/MF A01; 1	DE84001833	MN -60	9:460
CONF-8310104-	(Specialists meeting on yields and decay data of fission product nuclides, Upton, NY, USA, 24-27 Oct 1983)			
1	*See* LA-UR-83-3061	DE84001734	MN -34D	9:1081
2	*See* LA-UR-83-3074	DE84001724	MN -34C	9:1566
3	NTIS, PC A02/MF A01	DE84002056	MN -34C	9:509
CONF-8310111-	(11. DOE annual compatibility meeting, Livermore, CA, USA, 18-20 Oct 1983)			
5	*See* SAND-83-1367C	DE84001539	MN -4	9:824
CONF-8310121-	(SPE annual technical conference, San Francisco, CA, USA, 5-8 Oct 1983)			
4	*See* LBL-16329	DE84001096	MN -66a	9:450
5	*See* LBL-15594	DE84002571	MN -66b	9:436
CONF-8310131-	(American Society for Engineering Management annual meeting, Washington, DC, USA, 17 Oct 1983)			
2	*See* K/D-5443	DE84001655	MN -38	9:1720
CONF-8310143-	(11. NRC water reactor safety research information meeting, Gaithersburg, MD, USA, 14-28 Oct 1983)			
4	*See* UNI-SA-117	DE84000360	MN -78	9:500
CONF-8310144-	(Specialists' workshop on fission gas behavior in safety experiments, Cadarache, France, 5-7 Oct 1983)			
3	NTIS, PC A04/MF A01	DE84000591	MN -80	9:484
CONF-8310148-	(Los Alamos/CEA high explosives and detonation physics conference, Paris, France, 3-6 Oct 1983)			
7	*See* LA-UR-83-2541	DE84001921	MN -45	9:1151
9	*See* LA-UR-83-2540	DE83017266	MN -45	9:1150
CONF-8310163-	(18. international thermal conductivity conference, Rapid City, SD, USA, 3-5 Oct 1983)			
4	NTIS, PC A03/MF A01	DE84001964	MN -25	9:1019
5	NTIS, PC A02/MF A01	DE84001969	MN -25	9:765
6	NTIS, PC A02/MF A01	DE84001966	MN -25	9:828
7	NTIS, PC A02/MF A01; 1	DE84001963	MN -95d	9:674
8	NTIS, PC A02/MF A01; 1	DE84001979	MN -25	9:829
CONF-8310164-	(2. symposium on electromagnetic launch technology, Boston, MA, USA, 11-14 Oct 1983)			
3	*See* LA-UR-83-2710	DE84001174	MN -38	9:1032
4	*See* LA-UR-83-2716	DE84001168	MN -38	9:1033
5	*See* LA-UR-83-2717	DE84001202	MN -38	9:1034
CONF-8310169-	(Diffusion symposium, Philadelphia, PA, USA, 2-6 Oct 1983)			
1	*See* SAND-83-0591C	DE84000354	MN -34A	9:1595
CONF-8310172-	(Advances in soft x-ray science and technology conference, Upton, NY, USA, 17-20 Oct 1983)			
1	*See* LA-UR-83-2837	DE84001035	MN -34	9:1591
2	*See* LBL-16592	DE84001875	MN -28	9:1103
CONF-8310174-	(Forest environmental measurements conference, Oak Ridge, TN, USA, 23-28 Oct 1983)			
1	*See* DP-MS-83-12	DE84001409	MN -11	9:1174
CONF-8310175-	(36. annual Pacific Coast Regional meeting of the American Ceramic Society, San Diego, CA, USA, 3-5 Oct 1983)			
1	*See* HEDL-SA-2976	DE84001479	MN -25	9:493
2	*See* PNL-SA-11711	DE84000936	MN -85	9:813
CONF-8310176-	(International meeting on reduced enrichment for research and test reactors, Tokai, Japan, 24-31 Oct 1983)			
1	*See* DP-MS-83-76	DE84001593	MN -86	9:220
CONF-8310177-	(2. annual DOE geothermal progress review meeting, Washington, DC, USA, 11-12 Oct 1983)			
3	*See* SAND-83-1095C	DE84001647	MN -66c	9:452
CONF-8310179-	(8. international symposium on polynuclear aromatic hydrocarbons, Columbus, OH, USA, 26-28 Oct 1983)			
2	*See* LA-UR-83-3093	DE84001723	MN -48	9:1347
3	NTIS, PC A02/MF A01	DE84002060	MN -90i	9:1
CONF-8310180-	(Fall symposium of the American Flame Research Committee, Akron, OH, USA, 4-6 Oct 1983)			
1	NTIS, PC A03/MF A01	DE84002067	MN -90e	9:112
CONF-8310182-	(US fall DECUS symposium, Las Vegas, NV, USA, 24-28 Oct 1983)			
2	*See* PNL-SA-11715	DE84002584	MN -32	9:1754
CONF-8310183-	(International symposium on ceramic components for engines, Hakone, Japan, 17-21 Oct 1983)			
1	*See* UCRL-88966	DE84001766	MN -4	9:814
2	NTIS, PC A02/MF A01; 1	DE84001884	MN -25	9:809
CONF-8310184-	(National institute of child health and human development testis workshop, Bethesda, MD, USA, 14-17 Oct 1983)			
1	*See* UCRL-89917	DE84001786	MN -48	9:1326
CONF-8310185-	(3. pyrochemistry workshop, Golden, CO, USA, 25-26 Oct 1983)			
1	*See* DP-MS-83-103	DE84001534	MN -86	9:221

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CONF-8310186-	(Symposium on the GEM experience - an American education success story, Laurel, MD, USA, 18-19 Oct 1983)			
1	*See* DP-MS-83-75	DE84001530	MN -70B	9:239
CONF-8310190-	(Cullinet user's week, New Orleans, LA, USA, 3-6 Oct 1983)			
1	*See* Y/CSD/INF-83/3	DE84001653	MN -32	9:1749
CONF-8310191-	(21. Hanford life sciences symposium, Richland, WA, USA, 4-8 Oct 1983)			
1	*See* PNL-SA-11116	DE84002585	MN -48	9:1225
CONF-8310192-	(Geological Society of America annual meeting, Indianapolis, IN, USA, 31 Oct-3 Nov 1983)			
1	*See* RHO-BW-SA-298A-P	DE84001113	MN -70	9:269
2	*See* UCRL-89226	DE84002730	MN -11	9:1381
CONF-8310193-	(Arizona Consulting Engineers Association land subsidence symposium, Phoenix, AZ, USA, 21 Oct 1983)			
1	NTIS, PC A02/MF A01	DE84002569	MN -11	9:1379
CONF-8310194-	(Asilomar conference on circuits, systems and computers, Pacific Grove, CA, USA, 31 Oct-2 Nov 1983)			
1	*See* SAND-83-2267C	DE84002042	MN -32	9:1741
CONF-8310196-	(American Society of Nondestructive Testing conference, Dallas, TX, USA, 24 Oct 1983)			
1	*See* HEDL-SA-2986	DE84001463	MN -38	9:1023
CONF-8310197-	(DOE reproductive toxicology workshop, San Francisco, CA, USA, 12-14 Oct 1983)			
1	*See* UCRL-89918	DE84001763	MN -48	9:1290
CONF-8310199-	(Rivers '83 symposium, New Orleans, LA, USA, 24-26 Oct 1983)			
1	*See* SAND-83-0945C	DE84001791	MN -88	9:101
CONF-8310200-	(EPRI workshop, Palo Alto, CA, USA, 26-28 Oct 1983)			
1	NTIS, PC A03/MF A01	DE84001972	MN -95f	9:722
CONF-8310201-	(Combustion Institute fall meeting of the western states section, Los Angeles, CA, USA, 17-18 Oct 1983)			
1	*See* UCRL-89861	DE84001236	MN -96	9:750
CONF-8310202-	(Biotechnology fair, Knoxville, TN, USA, 13-14 Oct 1983)			
1-Draft	NTIS, PC A02/MF A01; 1	DE84001970	MN -69	9:723
CONF-8310203-	(DOE materials directors meeting, Los Alamos, NM, USA, 19-20 Oct 1983)			
1	NTIS, PC A02/MF A01	DE84001937	MN -25	9:766
CONF-8310205-	(TMS-AIME fall meeting, Philadelphia, PA, USA, 2-6 Oct 1983)			
1	*See* BNL-NUREG-33696	DE84001212	MN -70	9:760
CONF-8310208-	(Defense computers-graphics '83 meeting, Washington, DC, USA, 12-14 Oct 1983)			
1	*See* UCRL-89833	DE84000911	MN -32	9:1746
CONF-831105-	(Meeting of the Plasma Physics Division of the American Physical Society, Los Angeles, CA, USA, 7-11 Nov 1983)			
1	*See* GA-A-17276	DE84002388	MN -20g	9:1636
CONF-831111-	(ASME winter annual meeting, Boston, MA, USA, 13-18 Nov 1983)			
3	*See* LA-UR-83-1761	DE83014125	MN -32	9:1735
4	*See* BNL-NUREG-33096	DE83014103	MN -80	9:528
6	NTIS, PC A02/MF A01	DE83015692	MN -79	9:490
CONF-831171-	(American Vacuum Society meeting, Boston, MA, USA, 1-4 Nov 1983)			
8	*See* LA-UR-83-2694	DE84001305	MN -20d	9:1681
9	*See* BNL-33743	DE84002578	MN -37	9:1131
10	*See* LBL-16314	DE84002572	MN -34A	9:1437
11	*See* BNL-33742	DE84002576	MN -28	9:1086
CONF-831174-	(Materials Research Society annual meeting, Boston, MA, USA, 14-17 Nov 1983)			
3	*See* UCRL-89404	DE83018182	MN -70	9:272
4	*See* SAND-83-0535C	DE84002049	MN -70	9:1401
5	*See* SAND-83-1254C	DE84002383	MN -25	9:792
6	*See* SAND-83-1693C	DE84002046	MN -4	9:922
7	*See* SAND-83-2277C	DE84002536	MN -25	9:845
CONF-831187-	(MMM conference, Pittsburgh, PA, USA, 8-11 Nov 1983)			
5	*See* LA-UR-83-2890	DE84001685	MN -34	9:779
6	*See* LA-UR-83-2929	DE84001719	MN -34	9:781
7	*See* LA-UR-83-3064	DE84001731	MN -25	9:782
8	*See* UCRL-89424	DE84002024	MN -4	9:794
CONF-831190-	(7. Society of Petroleum Engineers reservoir simulation symposium, San Francisco, CA, USA, 15-18 Nov 1983)			
1	*See* LBL-16587	DE84001877	MN -92a	9:145
2	*See* LBL-16430	DE84001912	MN -92a	9:144
CONF-831192-	(Structures and mechanical behavior subcommittee, Laurel, MD, USA, 1-3 Nov 1983)			
1	*See* UCRL-88965	DE84002010	MN -11	9:1152
CONF-831193-	(Applicon user's group fall technical meeting, Detroit, MI, USA, 6-11 Nov 1983)			
1	*See* BDX-613-2981	DE84002420	MN -38	9:1728
CONF-831194-	(9. AIRAPT international conference on high pressure science and technology, Pittsburg, PA, USA, 8-11 Nov 1983)			
1	*See* LA-UR-83-2928	DE84001793	MN -34	9:780
CONF-831198-	(Eastern analytical symposium, New York, NY, USA, 16-18 Nov 1983)			
1	*See* DP-MS-83-43	DE84001760	MN -38	9:982

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CONF-831202-	(CHI '83 conference, Cambridge, MA, USA, 12-15 Dec 1983)			
1	*See* LA-UR-83-1207	DE83011175	MN -32	9:1732
2	*See* LA-UR-83-1392	DE83012664	MN -32	9:1733
CONF-831205-	(6. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 12-14 Dec 1983)			
2	*See* LA-UR-83-3028	DE84001735	MN -96	9:759
CONF-831208-	(14. computer measurement group conference, Washington, DC, US, 6-9 Dec 1983)			
1	*See* LA-UR-83-1500	DE83012778	MN -32	9:1734
CONF-831243-	(International electron device meeting, Washington, DC, USA, 5-7 Dec 1983)			
1	*See* SAND-83-1657C	DE84000136	MN -25	9:1040
2	*See* SAND-83-1639C	DE84000101	MN -37	9:1142
CONF-831245-	(8. international conference on infrared and millimeter waves, Miami Beach, FL, USA, 12-17 Dec 1983)			
1	*See* UCRL-89436	DE84001427	MN -4	9:924
CONF-831246-	(3. international school on sintered materials, New Delhi, India, 6-9 Dec 1983)			
1	*See* LA-UR-83-3045	DE84001736	MN -25	9:812
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1	*See* UCRL-89913	DE84002008	MN -32	9:1747
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1195-488	*See* DOE/ER/01195-488	DE84001568	MN -34D	9:1465
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83-02	NTIS (US Sales Only), PC A02/MF A01	DE83703679	MN -34C	9:1536
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005/ 81	NTIS (US Sales Only), PC A02/MF A01	DE83704261	MN -34A	9:1428
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83-022	NTIS (US Sales Only), PC A02/MF A01	DE83751335	MN -34D	9:1487
83-033	NTIS (US Sales Only), PC A02/MF A01	DE83751336	MN -34D	9:1488
83-035	NTIS (US Sales Only), PC A02/MF A01	DE83751334	MN -34D	9:1464
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83-041	Available from Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)			9:1489
83-046	Available from Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)			9:1507
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83-09	NTIS (US Sales Only), PC A11/MF A01	DE83751339	MN -25	9:810
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34	NTIS, PC A04/MF A01	DE84001027	STD -92a	9:140
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17	NTIS, PC A05/MF A01	DE84002019	STD -92a	9:141
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182	NTIS, PC A05/MF A01	DE84001883	MN -11	9:461
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T1	NTIS, PC A03/MF A01	DE84001390	MN -13	9:623
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0016/ 2	NTIS, PC A02/MF A01; 1	DE84002554	STD -95	9:671
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13	*See* LBL-16559	DE84001847	STD -94cd	9:297

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DOE/ER/10857-2	NTIS, PC A02/MF A01	DE84002280	MN -34A	9:1432
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10	NTIS, PC A03/MF A01	DE84002054	MN -48	9:1231
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26282	NTIS, PC A02/MF A01; 1	DE84001050	MN -80	9:508
26782	NTIS, PC A03/MF A01	DE84001051	MN -78	9:488

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EPA-				
450/ 3-82-022	*See* PB-83-234948			9:1219
600/ 7-83-017	NTIS, PC A04/MF A01	DE84900273	MN -11	9:93
600/ D-83-029	*See* PB-83-239749			9:1351
906/ 9-83-007	*See* PB-83-234153			9:1274
4900198	NTIS, PC A10/MF A01	DE84900198	MN -11	9:629
EPRI-NP-				
3225	NTIS, PC A08/MF A01	DE84001893	MN -70B	9:243
ESA-SP-				
181	*See* N-8323743			9:317
186	*See* N-8321006			9:603
ESC-WR-				
83-09	Available from ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98E	9:620
83-21	Available from ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -95f	9:638
ETEC-TDR-				
82-2	NTIS, PC A11/MF A01; 1	DE84000954	MN -79h	9:514
EUR-				
6993	NTIS (US Sales Only), PC A04/MF A01	DE83703738	MN -41	9:543
7446-FR/ DE	Available from Commission of the European Communities, Luxembourg			9:771
7700	NTIS (US Sales Only), PC A09/MF A01	DE83703700	MN -4	9:958
7765	NTIS (US Sales Only), PC A05/MF A01	DE83703739	MN -41	9:544
7824-EN	European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037		ND -63	9:330
8018	NTIS (US Sales Only), PC A09/MF A01	DE83703740	MN -41	9:545
8025-DE	Available from Commission of the European Communities, Brussels (Belgium)			9:298
8048-EN	*See* PB-83-242164			9:437
8050-EN	*See* PB-83-241026			9:642
8064-Vol.2-d	Commission of the European Communities, Luxembourg			9:58
8216-EN	*See* PB-83-241984			9:356
8218-EN	*See* PB-83-241992			9:431
8319-EN	Available from Commission of the European Communities, Luxembourg			9:621
8543-EN	European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037		ND -95	9:639
8593-EN	European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037		ND -95c	9:640
8603-DE-EN	European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037		ND -95f	9:734
EUR-CEA-FC-				
1172	NTIS (US Sales Only), PC A02/MF A01	DE83704270	MN -20	9:1634
1174	NTIS (US Sales Only), PC A02/MF A01	DE83704271	MN -20	9:1635
FE-				
2778-16	*See* DOE/ET/10324-T43	DE83010968	MN -90c	9:16
2778-24	*See* DOE/ET/10324-T44	DE83010970	MN -90c	9:17
2778-28	*See* DOE/ET/10324-T50	DE83010946	MN -90c	9:19
2778-36	*See* DOE/ET/10324-36	DE83010948	MN -90c	9:2
2778-43	*See* DOE/ET/10324-T25	DE83010967	MN -90c	9:14
2778-44	*See* DOE/ET/10324-T19	DE83010963	MN -90c	9:9
2778-45	*See* DOE/ET/10324-T17	DE83010962	MN -90c	9:8
2778-46	*See* DOE/ET/10324-T14	DE83010941	MN -90c	9:6
2778-47	*See* DOE/ET/10324-T39	DE83010945	MN -90c	9:15
2778-49	*See* DOE/ET/10324-T18	DE83010940	MN -90c	9:98
2778-50	*See* DOE/ET/10324-T15	DE83010969	MN -90c	9:7
2778-51	*See* DOE/ET/10324-T21	DE83010965	MN -90c	9:11
2778-52	*See* DOE/ET/10324-T20	DE83010959	MN -90c	9:10
2778-53	*See* DOE/ET/10324-T22	DE83010966	MN -90c	9:12
2778-54	*See* DOE/ET/10324-T24	DE83010964	MN -90c	9:13
2778-56	*See* DOE/ET/10324-T49	DE83010971	MN -90c	9:18
2778-60	*See* DOE/ET/10324-T53	DE83011001	MN -90c	9:21
2778-61	*See* DOE/ET/10324-61	DE83010943	MN -90c	9:3
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2778-65	*See* DOE/ET/10324-T52	DE83011002	MN -90c	9:20
2778-69	*See* DOE/ET/10324-69	DE83010951	MN -90c	9:4
2778-73	*See* DOE/ET/10324-73	DE83010950	MN -90c	9:5
2778-81	*See* DOE/ET/10324-T66	DE83010944	MN -90c	9:24
2778-85	*See* DOE/ET/10324-T64	DE83010942	MN -90c	9:23
FERMILAB/TM-				
1210	NTIS, PC A02/MF A01; 1	DE84002573	MN -28	9:1057
1211	NTIS, PC A02/MF A01; 1	DE84002528	MN -28	9:1052
1212	NTIS, PC A02/MF A01; 1	DE84002561	MN -28	9:1072
1213	NTIS, PC A02/MF A01	DE84002562	MN -28	9:1073
1214	NTIS, PC A02/MF A01	DE84002564	MN -28	9:1074
1215	NTIS, PC A02/MF A01; 1	DE84002563	MN -28	9:1058
1218	NTIS, PC A02/MF A01; 1	DE84002565	MN -28	9:1075
1219	NTIS, PC A02/MF A01; 1	DE84002566	MN -28	9:1076
FRA/ORD-				
77/ 34.I	NTIS		MN -25	9:1021
77/ 34.II	NTIS		MN -25	9:1022
FRNC-TH-				
1155	NTIS (US Sales Only), PC A08; 3	DE84750129	ND -59a	9:412
1158	NTIS (US Sales Only), MF A01; 2	DE84750126	MN -63	9:331

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1159	NTIS (US Sales Only), PC A07; 3	DE84750127	ND -62	9:429
FS-				
81-21-AKI	NTIS (US Sales Only), PC A04/MF A01	DE83751309	MN -41	9:1316
FWS/OBS-				
82/ 60-Vol.1	NTIS, PC A21/MF A01; 1	DE84900176	MN -11	9:1267
82/ 60-Vol.2	NTIS, PC A07/MF A01; 1	DE84900170	MN -11	9:1268
GA-A-				
17112	NTIS, PC A04/MF A01	DE84000299	STD -77	9:504
17276	NTIS, PC A03/MF A01	DE84002388	MN -20g	9:1636
GCA-TR-				
82-23-G(1)	*See* PB-83-240671			9:473
82-23-G(2)	*See* PB-83-240689			9:474
GEFR-				
00669	NTIS, PC A03/MF A01	DE84000288	STD -77	9:505
GJBX-				
35-83-Prescott-A-AZ-Vol.2A	NTIS, PC A17/MF A01; 1	DE84002748	MN -51	9:211
35-83-Prescott-A-AZ-Vol.2B	NTIS, PC A13/MF A01; 1	DE84002413	MN -51	9:212
35-83-Prescott-A-B-AZ-Vol.1	NTIS PC E08/MF $9.50; 1	DE84002507	MN -51	9:213
35-83-Prescott-B-AZ-Vol.2B	NTIS, PC A13/MF A01; 1	DE84002411	MN -51	9:209
35-83-Prescott-B-AZ-Vol.2A	NTIS, PC A17/MF A01; 1	DE84002412	MN -51	9:210
GKSS-				
82/ E/ 52	NTIS (US Sales Only), PC A02/MF A01	DE83751320	MN -20	9:1077
83/ E/ 9	NTIS (US Sales Only), PC A02/MF A01	DE83751327	MN -78	9:546
83/ E/ 13	NTIS (US Sales Only), PC A03/MF A01	DE83751342	MN -11	9:1175
83/ E/ 14	NTIS (US Sales Only), PC A03/MF A01	DE83751318	MN -11	9:1245
GPO-				
09-140	*See* N-8323716			9:646
11-258	*See* N-8323954			9:254
11-518	*See* N-8323956			9:1222
11-566	*See* N-8323715			9:652
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94-897	*See* N-8323717			9:647
95-065	*See* N-8323718			9:648
GRS-F-				
126	NTIS (US Sales Only), PC A04/MF A01	DE83751340	MN -80	9:547
GSF-OE-				
536	Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie			9:1344
GSF-S-				
936	NTIS (US Sales Only), PC A10/MF A01	DE83751315	MN -41	9:1317
GSF-T-				
136(Bd.2)	Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Muenchen, Neuherberg, Germany, F.R.			9:284
GSI-				
83-1	NTIS (US Sales Only), PC A16/MF A01	DE83751322	MN -2	9:635
GTFR-				
43	NTIS, PC A03/MF A01	DE84001857	MN -20g	9:1637
HAC-F-				
107-500-5	*See* DOE/NASA-0207-1	DE84001694	STD -63	9:353
HEDL-SA-				
2757-FP	NTIS, PC A02/MF A01	DE84001480	MN -79b	9:491
2847-FP	NTIS, PC A02/MF A01	DE84001494	MN -37	9:1110
2857-FP	NTIS, PC A02/MF A01	DE84001495	MN -79k	9:492
2859-FP	NTIS, PC A02/MF A01; 1	DE84001466	MN -37	9:1111
2864-FP	NTIS, PC A02/MF A01	DE84001477	MN -41	9:1112
2883	NTIS, PC A02/MF A01	DE84001487	MN -20c	9:1673
2896	NTIS, PC A02/MF A01; 1	DE84001474	MN -20c	9:1674
2907-FP	NTIS, PC A03/MF A01	DE84001500	MN -25	9:772
2910	NTIS, PC A02/MF A01	DE84001469	MN -20c	9:1675
2920	NTIS, PC A02/MF A01	DE84001465	MN -79a	9:525
2976	NTIS, PC A03/MF A01	DE84001479	MN -25	9:493
2986	NTIS, PC A03/MF A01	DE84001463	MN -38	9:1023
HEDL-TME-				
82-46-Rev.1	NTIS, PC A06/MF A01	DE84002740	STD -32	9:1729
83-27	NTIS, PC A04/MF A01	DE84002089	STD -20c	9:1676
HMI-P-				
83/ 2-HF(Preprint)	NTIS (US Sales Only), PC A02/MF A01	DE83751324	MN -34	9:1603
HW-				
77503	NTIS, PC A04; 3	DE84001845	ND -86	9:244
77503-Rev.1	NTIS, PC A04; 3	DE84001561	ND -86	9:245
IAEA-SM-				
266/ 63	*See* BNL-33788	DE84001693	MN -48	9:1599
IAEA-SR-				
84/ 4	NTIS, PC A02/MF A01; 1	DE84001965	MN -41	9:1234
85/ 4	NTIS, PC A02/MF A01	DE84001958	MN -11	9:1259
85/ 56	*See* UCRL-89766	DE84002721	MN -11	9:1235
IAEA-TECDOC-				
277	NTIS (US Sales Only), PC A09/MF A01	DE84780031	MN -20	9:1677

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IC-				
82/ 210	NTIS (US Sales Only), PC A02/MF A01	DE83703666	MN -34C	9:1569
82/ 211	NTIS (US Sales Only), PC A02/MF A01	DE83703667	MN -34C	9:1570
ICTIS/M-				
0165	Instituto Mexicano de Investigaciones Siderurgicas, Saltillo			9:48
IFP-				
30-664	NTIS (US Sales Only), PC A05/MF A01; 1	DE84750125	MN -4	9:939
30-953	NTIS (US Sales Only), PC A09/MF A01; 1	DE84750128	MN -92	9:187
IFSR-				
105	*See* DOE/ET/53088-105	DE84001562	MN -20	9:1631
108	*See* DOE/ET/53088-108	DE84001558	MN -20a	9:1632
111	*See* DOE/ET/53088-111	DE84000391	MN -20g	9:1633
IFT-M-				
01/ 81	NTIS (US Sales Only), PC A07/MF A01	DE83704249	MN -34D	9:1493
IFT-P-				
14/ 81	NTIS (US Sales Only), PC A02/MF A01	DE83704250	MN -34D	9:1571
15/ 81	NTIS (US Sales Only), PC A03/MF A01	DE83704251	MN -34D	9:1611
IFUSP-P-				
292	NTIS (US Sales Only), PC A02/MF A01	DE83704252	MN -34D	9:1511
295	NTIS (US Sales Only), PC A02/MF A01	DE83704253	MN -34D	9:1612
297	NTIS (US Sales Only), PC A02/MF A01	DE83704254	MN -34D	9:1613
303	NTIS (US Sales Only), PC A03/MF A01	DE83704255	MN -34D	9:1614
306	NTIS (US Sales Only), PC A02/MF A01	DE83704256	MN -34D	9:1615
307	NTIS (US Sales Only), PC A02/MF A01	DE83704257	MN -34D	9:1616
308	NTIS (US Sales Only), PC A04/MF A01	DE83704258	MN -34D	9:1010
309	NTIS (US Sales Only), PC A02/MF A01	DE83704259	MN -34D	9:1617
IKE-				
6-144	NTIS (US Sales Only), PC A08/MF A01	DE83751343	MN -80	9:773
28	NTIS (US Sales Only), PC A04/MF A01	DE83751330	MN -78	9:510
ILR-MITT-				
119	NTIS (US Sales Only), PC A04/MF A01	DE83751326	MN -70	9:250
INIS-mf-				
8566	NTIS (US Sales Only), PC A03/MF A01	DE83703668	MN -34C	9:1572
INPE-				
2013	NTIS (US Sales Only), PC A07/MF A01	DE83704275	MN -34B	9:1407
2093	NTIS (US Sales Only), PC A02/MF A01	DE83704272	MN -20	9:1638
2243	NTIS (US Sales Only), PC A07/MF A01	DE83704276	MN -34B	9:1424
2645-TDL/ 116	*See* N-8322594			9:749
IPEN-Pub-				
44	NTIS (US Sales Only), PC A03/MF A01	DE83703699	MN -4	9:882
IPP-				
III/ 78	NTIS (US Sales Only), PC A03/MF A01	DE83751316	MN -20	9:1639
IS-				
4818	NTIS, PC A02/MF A01; 1	DE83016406	MN -11	9:1345
4831	NTIS, PC A07/MF A01	DE84001676	MN -11	9:1176
4833	NTIS, PC A06/MF A01	DE84002633	MN -90	9:735
4839	NTIS, PC A04/MF A01	DE84001858	STD -90b	9:108
4840	NTIS, PC A02/MF A01; 1	DE84001795	MN -11	9:1177
4841	NTIS, PC A02/MF A01	DE84001550	MN -11	9:1178
IS-RIC-PR-				
6	NTIS, PC A04/MF A01; 1	DE84002631	MN -4	9:834
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ITEF-				
110(1982)	NTIS (US Sales Only), PC A03/MF A01	DE83704264	MN -34A	9:774
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127(1982)	NTIS (US Sales Only), PC A02/MF A01	DE83704277	MN -34B	9:1408
ITF-				
82-67-R	NTIS (US Sales Only), PC A04/MF A01	DE83704273	MN -20	9:1640
82-89-R	NTIS (US Sales Only), PC A02/MF A01	DE83704278	MN -34B	9:1409
ITP-				
82-54-E	NTIS (US Sales Only), PC A03/MF A01	DE83703669	MN -34C	9:1526
JAERI-				
1278	NTIS (US Sales Only), PC A05/MF A01	DE83703702	MN -4	9:1059
JAERI-M-				
82-032	NTIS (US Sales Only), PC A02/MF A01	DE83703707	MN -25	9:775
82-036	NTIS (US Sales Only), PC A02/MF A01	DE83703708	MN -25	9:776
82-053	NTIS (US Sales Only), PC A03/MF A01	DE83703686	MN -4	9:883
82-059	NTIS (US Sales Only), PC A03/MF A01	DE83703703	MN -4	9:951
82-060	NTIS (US Sales Only), PC A06/MF A01	DE83703741	MN -41	9:548
82-063	NTIS (US Sales Only), PC A02/MF A01	DE83703704	MN -4	9:1318
82-067	NTIS (US Sales Only), PC A02/MF A01	DE83703709	MN -25	9:835
82-070	NTIS (US Sales Only), PC A02/MF A01	DE83703687	MN -4	9:884
82-089	NTIS (US Sales Only), PC A03/MF A01	DE83703710	MN -25	9:836
JINR-				
18-82-245	NTIS (US Sales Only), PC A02/MF A01	DE83703688	MN -4	9:885
E-1-82-718	NTIS (US Sales Only), PC A02/MF A01	DE83703680	MN -34C	9:1548
E-2-82-680	NTIS (US Sales Only), PC A02/MF A01	DE83704260	MN -34D	9:1512
E-3-82-336	NTIS (US Sales Only), PC A02/MF A01	DE83703681	MN -34C	9:1541
E-4-82-572	NTIS (US Sales Only), PC A02/MF A01	DE83703670	MN -34C	9:1523

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R-1-82-688	NTIS (US Sales Only), PC A02/MF A01	DE83703663	MN -46	9:1588
R-1-82-689	NTIS (US Sales Only), PC A02/MF A01	DE83703664	MN -34C	9:1589
R-2-82-695	NTIS (US Sales Only), PC A02/MF A01	DE83703671	MN -34C	9:1573
R-2-82-696	NTIS (US Sales Only), PC A02/MF A01	DE83703672	MN -34C	9:1574
R-4-82-209	NTIS (US Sales Only), PC A02/MF A01	DE83703673	MN -34C	9:1575
R-4-82-385	NTIS (US Sales Only), PC A02/MF A01	DE83703674	MN -34C	9:1576
R-4-82-396	NTIS (US Sales Only), PC A02/MF A01	DE83703675	MN -34C	9:1538
R-4-82-810	NTIS (US Sales Only), PC A02/MF A01	DE83704262	MN -34A	9:1434
R-4-82-889	NTIS (US Sales Only), PC A02/MF A01	DE83704263	MN -34A	9:1435
R-7-82-707	NTIS (US Sales Only), PC A02/MF A01	DE83703682	MN -34C	9:1549
R-7-82-749	NTIS (US Sales Only), PC A02/MF A01	DE83704274	MN -20	9:1678
R-14-82-826	NTIS (US Sales Only), PC A02/MF A01	DE83704265	MN -34A	9:1436
JPL-				
9950-811	*See* N-8323713			9:332
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Juel-				
1787	NTIS (US Sales Only), PC A05/MF A01	DE84780032	MN -34D	9:1619
1819	NTIS (US Sales Only), PC A05/MF A01	DE83751344	MN -25	9:777
K/CSD/INF-				
83/ 20	NTIS, PC A05/MF A01	DE84002422	MN -32	9:1730
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5443	NTIS, PC A02/MF A01	DE84001655	MN -38	9:1720
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5022	NTIS, PC A02/MF A01	DE84001783	MN -78	9:549
5024	NTIS, PC A03/MF A01	DE84001872	MN -22	9:215
KFA-ASS-				
359	Available from Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe (Germany, F.R.)			9:1721
KFK-				
3342	NTIS (US Sales Only), PC A12/MF A01	DE83751341	MN -2	9:645
3499	NTIS (US Sales Only), PC A07/MF A01	DE83751337	MN -25	9:778
3511-B	NTIS (US Sales Only), PC A06/MF A01	DE83751317	MN -28	9:1564
3531	NTIS (US Sales Only), PC A04/MF A01	DE83751314	MN -41	9:886
3532	NTIS (US Sales Only), PC A02/MF A01	DE83751331	MN -4	9:887
3537	NTIS (US Sales Only), PC A03/MF A01	DE83751319	MN -80	9:511
3539	NTIS (US Sales Only), PC A04/MF A01	DE83751321	MN -34C	9:1577
3561	NTIS (US Sales Only), PC A03/MF A01	DE83751338	MN -78	9:550
KFTI-				
81-52	NTIS (US Sales Only), PC A05/MF A01	DE84780033	MN -34D	9:1053
KIYI-				
81-38	NTIS (US Sales Only), PC A02/MF A01	DE83703676	MN -34C	9:1565
82-1	NTIS (US Sales Only), PC A02/MF A01	DE83703683	MN -34C	9:1550
L-				
15566	*See* N-8323140			9:1578
15596	*See* N-8325525			9:1593
LA-				
8552-MS	NTIS, PC A02/MF A01	DE84002298	STD -11	9:1155
9642	NTIS, PC A02/MF A01	DE84002287	STD -41	9:1113
9645-MS	NTIS, PC A04/MF A01	DE84002323	STD -15	9:292
9678-PR	NTIS, PC A04/MF A01	DE84002270	STD -91	9:201
9728-M	NTIS, PC A03/MF A01	DE84002292	STD -32	9:1731
9751-MS	NTIS, PC A08/MF A01; 1	DE84002294	STD -32	9:1590
9774-MS	NTIS, PC A02/MF A01; 1	DE84002288	STD -20d	9:1679
9778-MS	NTIS, PC A02/MF A01	DE84002291	STD -41	9:1374
9779-PR	NTIS, PC A05/MF A01; 1	DE84002347	STD -41	9:1319
9783-PR	NTIS, PC A05/MF A01	DE84002296	STD -91	9:202
9785	NTIS, PC A02/MF A01	DE84002303	STD -34	9:1641
9789-MS	NTIS, PC A03/MF A01	DE84002316	STD -15	9:293
9793-PR	NTIS, PC A04/MF A01	DE84002271	STD -70	9:251
9795-MS	NTIS, PC A03/MF A01	DE84002295	STD -15	9:551
9827-PR	*See* NUREG/CR-3403	DE84002281	MN -41	9:1376
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4900286	Georgia Agricultural Experiment Station, 125 Barrow Hall-University of Georgia, Athens, GA 30602		MN -13	9:1348
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3901768	NTIS (US Sales Only), PC A02/MF A01; 1	DE83901768	MN -4	9:909
3901780	NTIS (US Sales Only), PC A02/MF A01	DE83901780	MN -95d	9:713
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5205	NTIS, PC A03/MF A01	DE84001843	MN -21	9:595
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0090-Vol.6-No.1	NTIS, PC A03/MF A01 - GPO	DE84900184	MN -80	9:558
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0828	NTIS, PC A99/MF A01; 1 - GPO $13.00	DE84900175	MN -78	9:559
0985-Vol.1	NTIS, PC A05/MF A01; 1 - GPO $4.50	DE84900280	MN -2	9:560
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2986	NTIS, PC A05/MF A01 - GPO	DE84001441	MN -80	9:566
3043	NTIS, PC A04/MF A01 - GPO	DE84001520	MN -80	9:567
3048	NTIS, PC A03/MF A01 - GPO $3.75	DE84900081	MN -78	9:485
3051	NTIS, PC A03/MF A01 - GPO $4.25	DE84900019	MN -78	9:568
3151	NTIS, PC A02/MF A01 - GPO	DE84002451	MN -25	9:823
3192	NTIS, PC A07/MF A01; 1 - GPO	DE84001514	MN -80	9:569
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3259	NTIS, PC A03/MF A01 - GPO	DE84001179	MN -70A	9:255
3288	NTIS, PC A06/MF A01; 1 - GPO	DE84001154	MN -79p	9:571
3299	NTIS, PC A13/MF A01 - GPO $7.50	DE84900041	MN -78	9:572

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3358	NTIS, PC A04/MF A01 - GPO	DE84001428	MN -11	9:1246
3382	NTIS, PC A04/MF A01 - GPO	DE84002392	MN -70	9:256
3384	NTIS, PC A05/MF A01 - GPO $4.50	DE84001153	MN -78	9:574
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196-34	NTIS, PC A04/MF A01	DE84001834	STD -70	9:257
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262	*See* ORNL-6003	DE84002741	MN -41	9:1324
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2591	NTIS (US Sales Only), PC A02/MF A01; 1	DE83902910	MN -97a	9:480
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4198	NTIS (US Sales Only), PC A02/MF A01	DE83703705	MN -4	9:952
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0414	Available by the Austrian Academy of Sciences, Dr. Ignaz Seipelplatz 2, 1010 Vienna		ND -48	9:1323
0415	Available by the author, OEFZS, A-2444 Seibersdorf, Austria		ND -41	9:1123
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8657	NTIS, PC A04/MF A01	DE84002380	MN -66c	9:444
8730	NTIS, PC A03/MF A01	DE84001140	MN -78	9:577
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8759	NTIS, PC A04/MF A01	DE84002263	MN -70	9:228
8767	NTIS, PC A03/MF A01	DE84002267	STD -20f	9:1684
8827	NTIS, PC A02/MF A01	DE84000346	MN -48	9:1299
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110-82-005	California Energy Commission, 1516 9th Street, Sacramento, CA 95814		MN -98E	9:660
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HT	Haiti
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HV	Upper Volta
IA	Inter-American Nuclear Energy Commission
IB	International Bank for Reconstruction and Development
ID	Indonesia
IE	Ireland
IG	Inter-Governmental Maritime Consultative Organization
II	International Commission on Radiation Units and Measurements
IL	Israel

IN India
IO International Labor Organization
IP International Union of Pure and Applied Physics
IQ Iraq
IR Iran
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IX International Union of Pure and Applied Chemistry

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KP Democratic People's Republic of Korea
KR Korea, Republic of
KW Kuwait

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OE Organization for Economic Cooperation and Development
OM Oman

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SY Syria
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TC Trucial Oman
TD Chad
TG Togo
TH Thailand
TN Tunisia
TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UE United Nations Educational, Scientific and Cultural Organization
UF United Nations Children's Fund
UG Uganda
UI United Nations Industrial Development Organization
US United States of America (USA)
UY Uruguay

VA Holy See
VD Democratic Republic of Viet-Nam
VE Venezuela
VS Republic of Viet-Nam

WM World Meteorological Organization
WS Western Samoa

XA International Atomic Energy Agency (IAEA)
XC European Organization for Nuclear Research (CERN)
XE Commission of the European Communities (CEC)
XF Food and Agriculture Organization of the United Nations (FAO)
XJ Joint Institute for Nuclear Research (JINR)
XM Council for Mutual Economic Assistance (CMEA)
XN Nuclear Energy Agency of the OECD (NEA)
XO Organization of African Unity (OAU)
XR International Commission on Radiological Protection (ICRP)
XS International Organization for Standardization (ISO)
XU United Nations (UN)
XW World Health Organization (WHO)
XX World Energy Conference (WEC)

YD Democratic Yemen
YE Yemen
YU Yugoslavia

ZA South Africa
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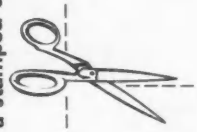

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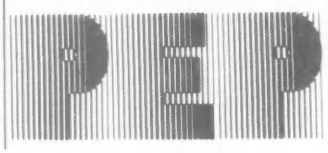

PEP is a customized computer search service provided on DOE/RECON (the Department's interactive on-line information retrieval system). PEP automatically supplies the latest information in your field of interest by searching any of the regularly updated data bases in DOE/RECON twice a month, printing out the new bibliographic entries defined by your particular search, and mailing the update to you.

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To obtain additional information about the specifics of subscribing to the PEP search service, or for examples of PEP search results, contact the library at your facility. If you do not have a library at your facility, contact David Bost, Director, Science and Technology Division, U. S. Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, TN; phone (615) 576-1155, FTS 626-1155.

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